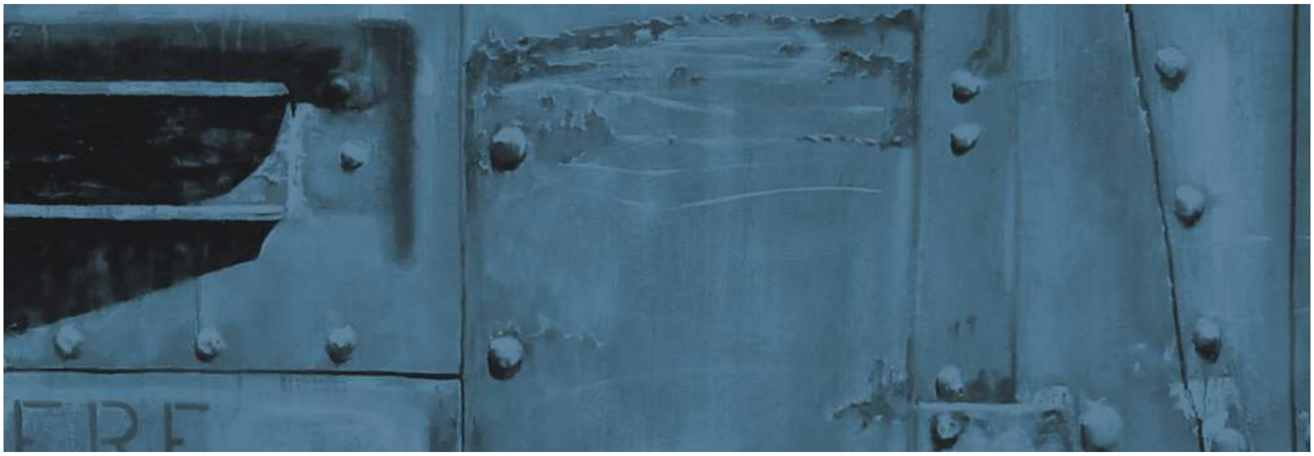

Hyla Crossing Pumped Stormwater Discharge

Issaquah, WA

Preliminary Technical Information Report

December 2018 | City of Issaquah Submittal

kpff Consulting Engineers

Preliminary Technical Information Report

December 2018

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Rowley Properties

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1. Executive Summary

The 2011 Master Drainage Plan for Rowley Center and Hyla Crossing (MDP) outlined a strategy to pump stormwater directly to Lake Sammamish as an alternative to traditional surface or buried stormwater detention due to challenging site parameters that include direct discharge to Tibbetts Creek, high groundwater conditions, flat site, and shallow invert elevations for storm infrastructure. This pumping alternative was issued a Mitigated Determination of Non-Significance (MDNS) by the City of Issaquah on March 14, 2012. The MDP was clarified in October 27, 2014 to identify Rowley Center as part of the “Central Issaquah Area Alternative Flow Control Standards” defined in the 2011 City of Issaquah Addendum to the 2009 King County Surface Water Design Manual (Drainage Code). This effectively removed the need to pump Rowley Center.

The intent of this Preliminary Technical Information Report (TIR) is to document the project concept, design parameters, and modeling technique for the purpose of informing the City of Issaquah of our design assumptions and approach in order to obtain preliminary approval and/or guidance prior to engaging in permit level design. Technical discussion is provided in the body of this report, with supporting worksheets, plans/profiles/sections, calculations, and figures included in the appendices.

Items that require review and approval or guidance as part of this Preliminary TIR include the following:

- Hydraulic and Hydrologic design parameters such as:
  - Pumped discharge is a substitute for traditional storm detention facilities. The pumped discharge will be equal to the Level 2 Flow Control requirements in the 2009 KCSWDM and the 2011 City of Issaquah Addendum. Base flows and flood flows in excess of Level 2 Flow Control requirements will be routed to Tibbetts Creek as described in the KPFF Technical Memorandum titled, “Force Main Preliminary Sizing Study – Rowley Properties, Issaquah, WA,” dated September 9, 2015 (Sizing Study). See Appendix E for the complete technical memo. Note that this analysis was the basis for the 18-inch (inside diameter) pipe installed in 2017 as part of the NW Poplar Way Road & Utility Improvements required for the Mull Property development. Our pump system will connect to this pipe.
  - The MDNS was based on a 42-inch force main and new piped outfall to Lake Sammamish as described in the December 2011 Master Drainage Plan (MDP). The system proposed in this TIR utilizes an 18-inch inside diameter force main with a dispersion trench outfall to the City of Issaquah’s Greenwood Trust Property.
  - Predevelopment hydrology assumes seasonal saturated soils for Hyla Crossing based on the Northwest Hydraulics Consultant study dated September 27, 2011 and to be confirmed by monitoring wells installed this winter.
  - This system only applies to a 42.9-acre stormwater collection area within Hyla Crossing. See Appendix B for drainage area map.
  - Assume an 84% impervious surface final developed condition.
  - Approach to splitting and conveying flows to the creek and lake.
  - 2012 Western Washington Hydraulic Models (WWHM2012) and Excel modeling approach.
- Wetland dispersion trench as conveyance to lake versus deep lake outfall.
- Location of pump station, flow dispersion trench, and Tibbetts Creek outfall

- Submersible pumps versus vertical turbine pumps.

Items that will be submitted at permit level review include the following:

- Phased development plan detailing future conveyance system to pump station.
- Detailed piping layout within pump house.
- Structural design of the pump house.
- Architectural design of the pump house ensuring National Electric Code and mechanical systems clearance compliance.
- Electrical design and documentation of pump house and backup generator.
- Detailed civil design plans and final TIR including documentation of anticipated construction means and methods.

2. Project Overview

Hyla Crossing is a collection of developed parcels totaling approximately 60 acres located in Issaquah, Washington, in the valley south of Interstate 90 bounded by Tibbetts Creek and SR-900. See the Site Location figure below.

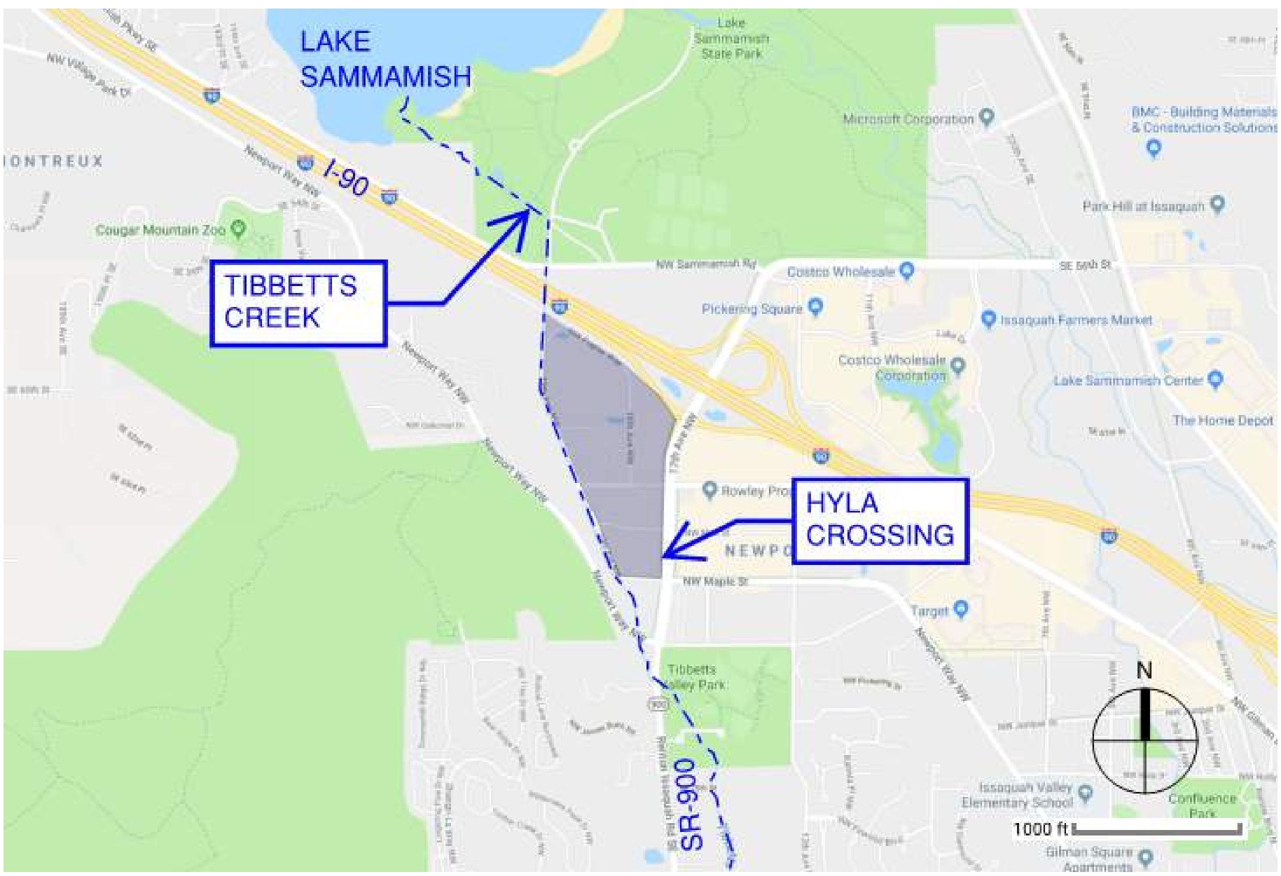


Figure 2-1: Site Location

Hyla Crossing is currently fully developed with various commercial land uses. The land cover is predominantly impervious, consisting of building roofs, roads, and surface parking with associated landscaped parking islands. Slopes are generally flat averaging 0.8% sloping down from south to north.

Hyla Crossing currently discharges to Tibbetts Creek via piped conveyance or the roadside ditch along SR-900 and Interstate 90 without any flow control. Approximately two-thirds of Hyla Crossing receives some level of water quality treatment through a combination of filter vaults and stormwater ponds. See Appendix B for the Existing Sub-basin Connectivity map.

In order to redevelop incrementally within Hyla Crossing, a stormwater force main with overland discharge to Lake Sammamish via dispersion trench will be constructed to provide flow control. This concept is in accordance with the MDP and is further defined in this TIR. Although the MDP recommended a piped outfall directly to the lake, we recommend a dispersion trench outfall in the upland City of Issaquah Greenwood Trust Property Wetland. A dispersion trench will have a smaller environmental impact during construction than a lake outfall and will positively provide added flow to the wetland. The wetland has been impacted by past agricultural development and further hydraulically separated from surrounding area by the construction of Interstate-90. This additional flow will significantly improve the wetland hydrology and ecosystem. See Attachment B of the MDP for a 1936 aerial photo showing the agricultural modifications in the area. See Appendix C for the Critical Areas Existing Conditions Summary Memo by Talasaea Consultants for further discussion.

The Lake Sammamish force main will pump flows in excess of those permitted to discharge to Tibbetts Creek to Lake Sammamish via dispersion trench and overland sheet flow. In a traditional detention facility, inflows are larger than outflows with the flow difference stored in the live detention volume until the storm passes. With the proposed Lake Sammamish force main, the flow difference is pumped to the Lake Sammamish dispersion trench. Lake Sammamish is a Direct Receiving Water that is exempt from flow control requirements.

Drainage will be collected from existing and future infrastructure within Hyla Crossing and redirected to the proposed pump station. The pump station includes flow splitting devices to send allowable base flows to Tibbetts Creek while pumping the excess to the Lake Sammamish dispersion trench. Since Tibbetts Creek is relatively shallow in the vicinity of the planned pump station, a second smaller pump is required to pump the base flows to Tibbetts Creek. An overflow weir directs flood flows to Tibbetts Creek via gravity in accordance with Level 2 Flow Control standards.

Since Hyla Crossing will be redeveloped incrementally, a phased drainage strategy will be implemented to demonstrate compliance with Level 2 flow control requirements. As parcels are redeveloped, conveyance systems will be constructed to convey runoff from the new surfaces to the pump station. These conveyances will be sized to accept upstream flow from the build-out condition. Additionally, each parcel development will be responsible to meet applicable water quality standards prior to discharge to the conveyance. Although this TIR describes the full build-out weir and orifice configuration, each parcel development will require a separate analysis and modification to the pump station weir and orifice structures. The weir and orifice structures within the pump station will be constructed from large sheet metal plates bolted to the concrete walls to allow flexibility. These sheet metal weir and orifice plates are easily replaced or modified without any structural modifications.

The final build-out sized pumps are constructed with this project and will have longer cycle times until the build-out condition is reached. Longer cycle times are not a concern as the pumps will initially require less run time and maintenance.

3. Conditions and Requirements Summary

As described in the Sizing Study, the applicable stormwater codes used in design are as follows in order of precedence:

1. December 2011 Rowley Center and Hyla Crossing MDP
2. Rowley Development Agreement Appendix I - Utilities
3. 2011 City of Issaquah Addendum to the 2009 King County Surface Water Design Manual (KCSWDM)
4. 2009 KCSWDM

The MDP is stated to be a working document based on the City and County codes that allows for flexibility. As confirmed in an October 14, 2015, email correspondence with Doug Schlepp, City of Issaquah DSD Consultant – RH2, the pertinent requirement in the MDP is Level 2 Flow Control. See Appendix B for the email correspondence and Appendix E for the Sizing Study.

CORE REQUIREMENT NO. 1: DISCHARGE AT THE NATURAL LOCATION

Two threshold discharge areas (TDAs) exist within Hyla Crossing, both tributary to Tibbetts Creek. These TDAs are labeled TDA No. 1 and TDA No. 3 in the MDP Attachment C, "Modeled Areas Map." The discharge points are approximately 1/2 mile apart along Tibbetts Creek. Specifically, TDA No. 1 reaches Tibbetts Creek via the ditch on the south side of the Interstate 90 right-of-way (ROW). As noted in the MDP, Section 2.8, the project proposes combining TDA Nos. 1 and 3's discharge points to a single discharge point at TDA No. 1's natural location.

CORE REQUIREMENT NO. 2: OFF-SITE ANALYSIS

The proposed Lake Sammamish force main discharges to the wetland within the City of Issaquah's Greenwood Trust Property via a dispersion trench weir system. See Section 6 for weir calculations and Section 7 for additional wetland information and study.

A full downstream analysis of Tibbetts Creek was performed by KPFF in July 2010 and is included in the MDP as Attachment B, "Existing Stormwater Conditions Report." This analysis is still applicable; therefore, a new downstream analysis of Tibbetts Creek is not necessary for the proposed project.

CORE REQUIREMENT NO. 3: FLOW CONTROL

The proposed project discharges are in conformance with Level 2 flow control as described in the 2011 City of Issaquah Addendum to the 2009 KCSWDM and the 2009 KCSWDM. See Section 5 for additional information.

CORE REQUIREMENT NO. 4: CONVEYANCE SYSTEM

The existing Hyla Crossing conveyance to Tibbetts Creek is via a 12-inch pipe originating at the existing stormwater pond discharging to the ditch on the south side of Interstate-90. This outfall pipe collects undetained runoff from approximately 30 acres and is currently undersized at 12 inches. This project proposes to upgrade this outfall to a 36-inch pipe to adequately convey overflows to Tibbetts Creek. The Lake Sammamish force main to the dispersion trench is a nominal 18-inch inside diameter HDPE pipe matching the existing force main pipe previously installed in NW Poplar Way. The Sizing Study and subsequent Pre-Wetland condition modification determined the size pipe installed in 2017 under NW Poplar Way to be 18-inch inside diameter. This size force main allows for an efficient pump design without producing significant head loss from large velocities. See Section 5 for additional discussion on the Pre-Wetland condition. See Section 6 for conveyance calculations and Section 7 for additional pump station information and study. See Appendix E for the Sizing Study and subsequent Pre-Wetland condition modification.

CORE REQUIREMENT NO. 5: EROSION AND SEDIMENT CONTROL

Best Management Practices will be implemented throughout construction in compliance with City of Issaquah and National Pollutant Discharge Elimination System (NPDES) standards. See Section 9 for additional information.

CORE REQUIREMENT NO. 6: MAINTENANCE AND OPERATIONS

The stormwater facilities proposed in this project require regular maintenance to prolong their life and ensure proper function. See Section 11 for additional information. As indicated in the MDP, the City of Issaquah will own, operate, and maintain the proposed stormwater facility including the pump station, conveyance to the Greenwood Trust Property Wetland, and the dispersion trench system.

CORE REQUIREMENT NO. 7: FINANCIAL GUARANTEES AND LIABILITY

Financial guarantees must be in place to ensure the stormwater facilities are constructed if the project loses funding during construction. See Section 10 for additional information.

CORE REQUIREMENT NO. 8: WATER QUALITY

Subsequent developments will be required to provide water quality treatment prior to discharging to the pump station. As such, water quality facilities are not proposed with this project.

4. Off-Site Analysis

The Greenwood Trust Property wetland is continuously sloped at approximately 0.7 percent toward Lake Sammamish without any closed depressions and is thickly matted with Reed Canary Grass. See Section 7 for additional wetland information and study and Appendix C for the Critical Areas Existing Conditions Summary Memo by Talasaea Consultants, Inc. which further describes the wetland.

5. Flow Control and Water Quality Facility Analysis and Design

The Hyla Crossing site area used in the flow control analysis totals 42.9-acres and is delineated in Attachment H, “EIS Technical Analysis: Critical Areas, Plants, Animals, and Water Quality,” Figure 5, of the MDP. The Existing Vegetated Buffer and Additional Buffer Enhancement areas (orange and cross-hatched orange) are excluded since they are required to be outside of future development. These buffer areas are assumed to planted similarly to their historic condition and drain via sheet flow directly to Tibbetts Creek.

The City of Issaquah published a drainage basin study titled, "Central Subarea Basin Planning Analysis – Pre-development Hydrology" dated September 27, 2011, by Northwest Hydraulic Consultants. This study recommended that certain areas within the Issaquah valley floor use a saturated pre-developed surface type. This results in larger pre-developed flows and smaller post-developed detention volumes. Hyla Crossing falls within the Seasonally Saturated area with a small portion within the Potentially Saturated areas. The design uses the saturated pre-developed surface type for the entire site and a geotechnical investigation is currently underway to confirm this assumption

Flows are discharged to Tibbetts Creek according the Level 2 Flow Control standard. Flows in excess of the Level 2 Flow Control standard are pumped to the Lake Sammamish dispersion trench with flow splitting accomplished at the pump station. As Hyla Crossing is developed, the flow splitter will need to be modified with each development to ensure compliance with Level 2 Flow Control; however, the piping and pumps are sized to convey the full build-out condition. See Appendix B for the Drainage Basin Map showing the assumed pump station's build out collection area. There are no bypass areas in the design meaning that only the areas conveyed to the pump station are considered mitigated.

Flow splitting is accomplished using three orifice-weir walls: Tibbetts Creek force main, Lake Sammamish force main, and Tibbetts Creek overflow. These walls divert the allowable flows to Tibbetts Creek while other flows are directed to the Lake Sammamish dispersion trench. The pumping sumps are situated below the orifice-weir walls such that the live storage required for pumping does not introduce a tailwater condition on the orifice-weir walls. See Appendix A for pump station plan and section figures.

Modeling the pump station and flow splitter requires two separate continuous runoff models and hydraulic calculations performed in an Excel spreadsheet. In order to facilitate the design process, MGS Flood was initially used as it is a more stable, reliable, and efficient software. The MGS Flood models were then rebuilt using the 2012 Western Washington Hydraulic Model (WWHM2012) to be in compliance with the City of Issaquah modeling software requirements. The original MGS Flood models are available upon request. The first WWHM2012 model, "Detention Vault," is used to determine the configuration of the Tibbetts Creek Force Main and Overflow orifice-weir walls. The detained volume in this calculation is irrelevant to the design. The pertinent information is the orifice configuration and riser diameter. The orifice configuration determined in this model is used for the Tibbetts Creek Force Main orifice-weir wall. The Tibbetts Creek Overflow wall weir length equals the circumference of the modeled riser pipe.

The second model, "Pump Station," and an Excel spreadsheet are used to determine the orifice and weir configuration of the Lake Sammamish orifice-weir wall. "Pump Station" uses a custom Stage-Storage-Discharge link to simulate the three orifice-weir walls. The "Manual" discharge column is copied directly from the "Detention Vault" model's discharge to mimic the allowable discharge to Tibbetts Creek. The "Infiltration" column represents the discharge to the Lake Sammamish force main. This column is copied from the Excel spreadsheet based on vertical notch discharge calculations. The configuration of the notch is iterated in Excel, and then copied into the WWHM2012 model until the Level 2 requirements are met.

The maximum pumped flow to each force main is calculated by determining the discharge from each orifice-weir wall at the Tibbetts Creek overflow elevation.

See Figure 5-1 for Flow Compliance Graphs, Table 5-1 for Flow Summary, and Appendix B for WWHM2012 output.

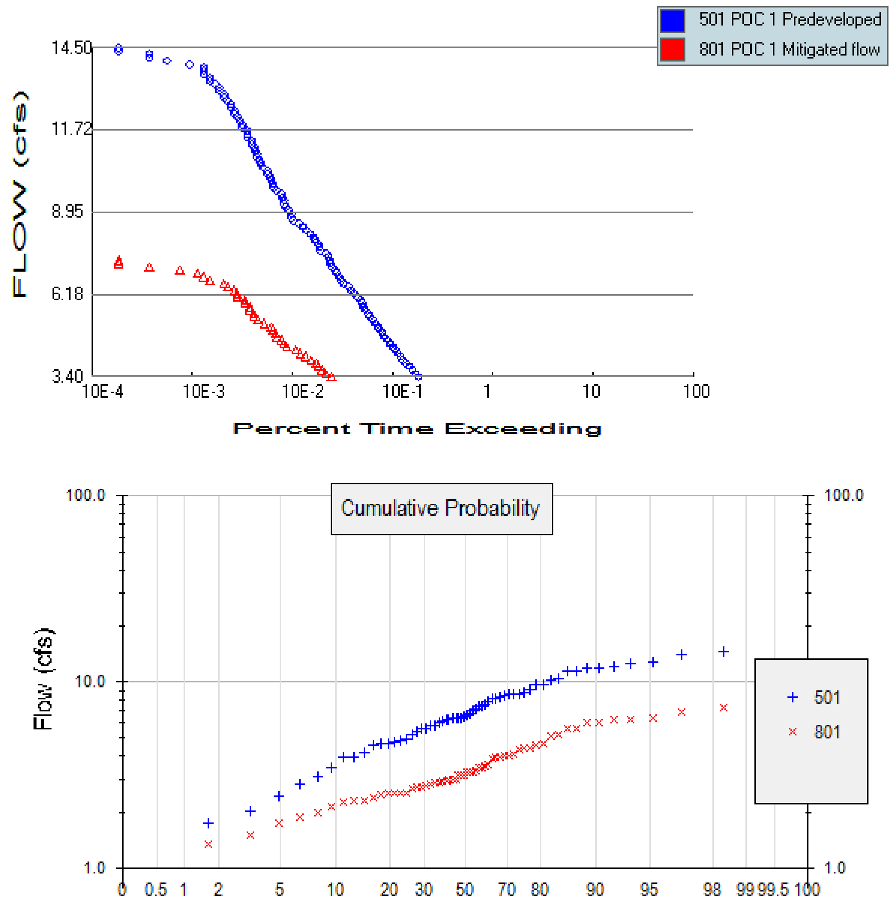


Figure 5-1: Duration and Peak Flow Compliance Graphs

Table 5-1: Flow Summary

Return Period (Years)	Predeveloped Saturated Peak Flow Tibbetts Creek (CFS)	Mitigated Peak Flow Tibbetts Creek (CFS)	Mitigated Peak Flow Lake Sammamish (CFS)
2	6.81	3.31	4.39
5	9.78	4.62	4.81
10	11.47	5.50	5.38
25	13.31	6.63	6.43
50	14.50	7.48	7.49
100	15.55	8.34	8.80

6. Conveyance System Analysis and Design

The primary conveyance to Lake Sammamish and Tibbetts Creek is via submersible pump and force main. As described in Section 5, the pump sizes chosen are large enough to convey the maximum flows through each of the respective weir and orifice walls. The force main size ensures an efficient flow regime without significant head losses from large velocities. See Table 6-1 for the maximum velocities in each force main.

Table 6-1: Pump Summary

Pump	Maximum Pump Capacity (CFS)	Force Main Inside Diameter (Inches)	Maximum Velocity (FPS)
Lake Sammamish	10.50	18	5.94
Tibbetts Creek	8.76	18	4.96

Flood flows will overtop the overflow weir at the pump station and discharge via gravity though an upgraded 36-inch pipe to the ditch on the south side of Interstate-90, maintaining the natural discharge point. Tibbetts Creek base flows will discharge via force main to the upgraded 36-inch pipe as well. This ditch is tributary to Tibbetts Creek approximately 200-feet north of the pump station through a piped outfall near the WSDOT improved section of Tibbetts Creek. This ditch currently has regular standing water and may require maintenance to improve its current hydraulic capacity. Upgrading the outfall to the Interstate-90 ditch is preferred over creating a new Tibbetts Creek outfall in the vicinity of the pump station because near the pump station Tibbetts Creek has very steep banks prone to erosion.

Pumped flow will reach Lake Sammamish via force main and dispersion trench within the City of Issaquah's Greenwood Trust Property Wetland. A portion of this force main has already been installed. The existing force main starts at the east side of Tibbetts Creek, crosses under the creek, then travels west in NW Poplar Way ending at the proposed Interstate-90 crossing location. The proposed Lake Sammamish force main will connect the pump station to the existing force main on the east side of Tibbetts Creek. The existing force main will be extended to the Greenwood Trust Property Wetland under Interstate-90 and NW Sammamish Road. The Interstate-90 and NW Sammamish Road crossing will be accomplished using trenchless construction. Trenchless construction means and methods are currently under investigation to help inform the design and reduce construction risks and impacts. The project team is presently in coordination with WSDOT to ensure these means and methods are appropriate for use under Interstate-90. See Appendix A for trenchless construction staging area figures.

After crossing under Interstate-90 and NW Sammamish Road, the force main turns west and parallels NW Sammamish Road for 570-feet until turning north into the Greenwood Trust Property Wetland. The dispersion trench is located at the most upstream end of the Greenwood Trust Property Wetland. The orientation of the dispersion trench parallels the existing contours so than minimal change to existing grade is necessary. This location allows for flow to travel the maximum distance within the wetland thereby providing the maximum hydrologic benefit. See Appendix A for the force main plans showing the location of the dispersion trench within the Greenwood Trust Property Wetland and Appendix C for the Critical Areas Existing Conditions Summary Memo by Talasaea Consultants, Inc. which further describes the benefits of locating the dispersion trench within the wetland.

The outfall structure in the Greenwood Trust Property Wetland dissipates the energy in the pumped stormwater by directing it over a horizontal weir opening in a 60-inch manhole. This weir opening allows the pumped flows to fill the manhole prior to spilling over into the dispersion trench. Since the force main entrance to the manhole is below the weir opening, velocity head will be dissipated within the manhole prior to discharge. See Appendix B for weir opening length calculations.

The dispersion trench is an 80-foot-long, 2-foot-wide, bottomless concrete structure with the top of concrete level with existing grade. The floor of the structure is open graded gravel to encourage infiltration and reduce standing water after rain events. The downstream wall of the structure is notched and acts as a weir wall to spread the pumped flows over a large area, encouraging downstream sheet flow and minimizing erosion. Shear stress calculations for the flow immediately downstream of the dispersion trench are used to calculate the minimum weir length. See Appendix A for Force Main Plans showing the force main alignment and Appendix B for shear stress calculations, weir calculations, and dispersion trench details. See Table 6-2 below for maximum flow depths and sear stresses at each weir.

Table 6-2: Outfall Weir Length Summary

Weir	Max Flow (CFS)	Weir Length (FT)	Depth Over Weir At Max Flow (IN)	Downstream Shear Stress at Max Flow (LB/SF)
Manhole Opening	10.50	5.60	8.28	N/A
Dispersion Trench	10.50	80.00	1.44	0.49

7. Special Reports and Studies

A pump and piping configuration study was performed as part of this preliminary TIR to determine the best use of the limited space between the Tibbetts Creek future buffer enhancement line and the existing 19th Avenue West. The two pumping options considered were vertical turbine pumps as recommended in the MDP and submersible pumps. See Table 7-1 below for the pros and cons of each pump configuration option.

Table 7-1: Pump Configuration Options

	Vertical Turbine Pump	Submersible Pump
Maintenance	Simple maintenance for above grade motor. Impeller and shaft maintenance require a separate crane to lift heavy equipment in and out of pumping chamber.	Integral winch included in the pump house lifts the pump out of the chamber and places it in a dedicated maintenance area within the pump house. No separate crane required.
Pump Station Footprint	Since the motors are above grade, there is less room for the valves and electrical equipment above grade. This configuration requires a larger less efficient footprint to allow motors, valves, and electrical equipment to share the same space. The required footprint for the vertical turbine pumps is not available between the buffer enhancement line and 19th Avenue West.	Motors are located below grade allowing for smaller footprint. Valves and electrical equipment have larger clearances. Larger area available for pump maintenance. The required footprint for the submersible pumps is available between the buffer enhancement line and 19th Avenue West.

Based on the limited area available for the pump station and maintenance considerations, we recommend submersible pumps. The smaller footprint required for the submersible pumps also allows for less work within the groundwater table, approximately 4-feet below grade.

Critical area and pump studies have been prepared in support of this TIR. See Appendix C for the Critical Areas Existing Conditions Summary Memo by Talasaea Consultants, Inc. and Appendix D for Pump Options by Notkin Mechanical Engineers.

8. Other Permits

The following permits are required for the construction of the project:

1. Shoreline Substantial Development (Issaquah)
2. Shoreline CUP or Variance (Issaquah)
3. Clearing/Grading (Issaquah)
4. ROW Use Permit (Issaquah)
5. Federal Highway Administration, Section 4F (Federal)
6. Hydraulic Project Approval (WDFW)
7. NPDES Construction Stormwater General Permit (Ecology)
8. NPDES Phase II Municipal Permit Site Plan Review (Issaquah)
9. Section 404 Fill permit (Army Corps)

9. Temporary Erosion and Sediment Control Design

Construction Stormwater Pollution and Prevention Plan Analysis and Design information will be added to this TIR at a later submittal.

10. Bond Quantity Worksheet and Declaration of Covenant

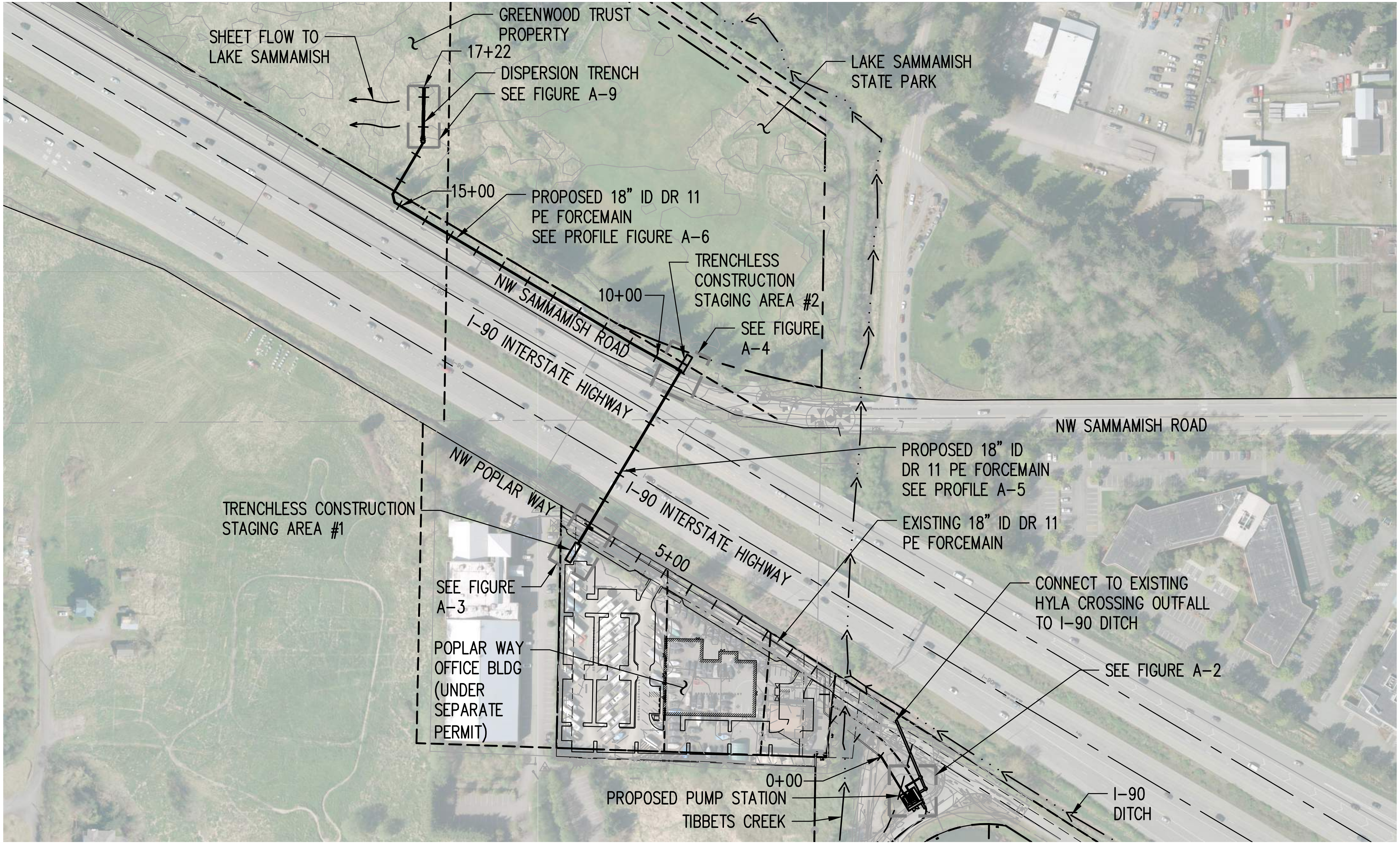
Bond Quantities, Facility Summaries, and Declaration of Covenant documents will be added to this TIR at a later submittal.

11. Operations and Maintenance Manual

The Operations and Maintenance Manual will be added to this TIR at a later submittal. See Appendix A for the Pump Station Layout figure showing the pump maintenance area and hoisting system.

Appendix A

Maps



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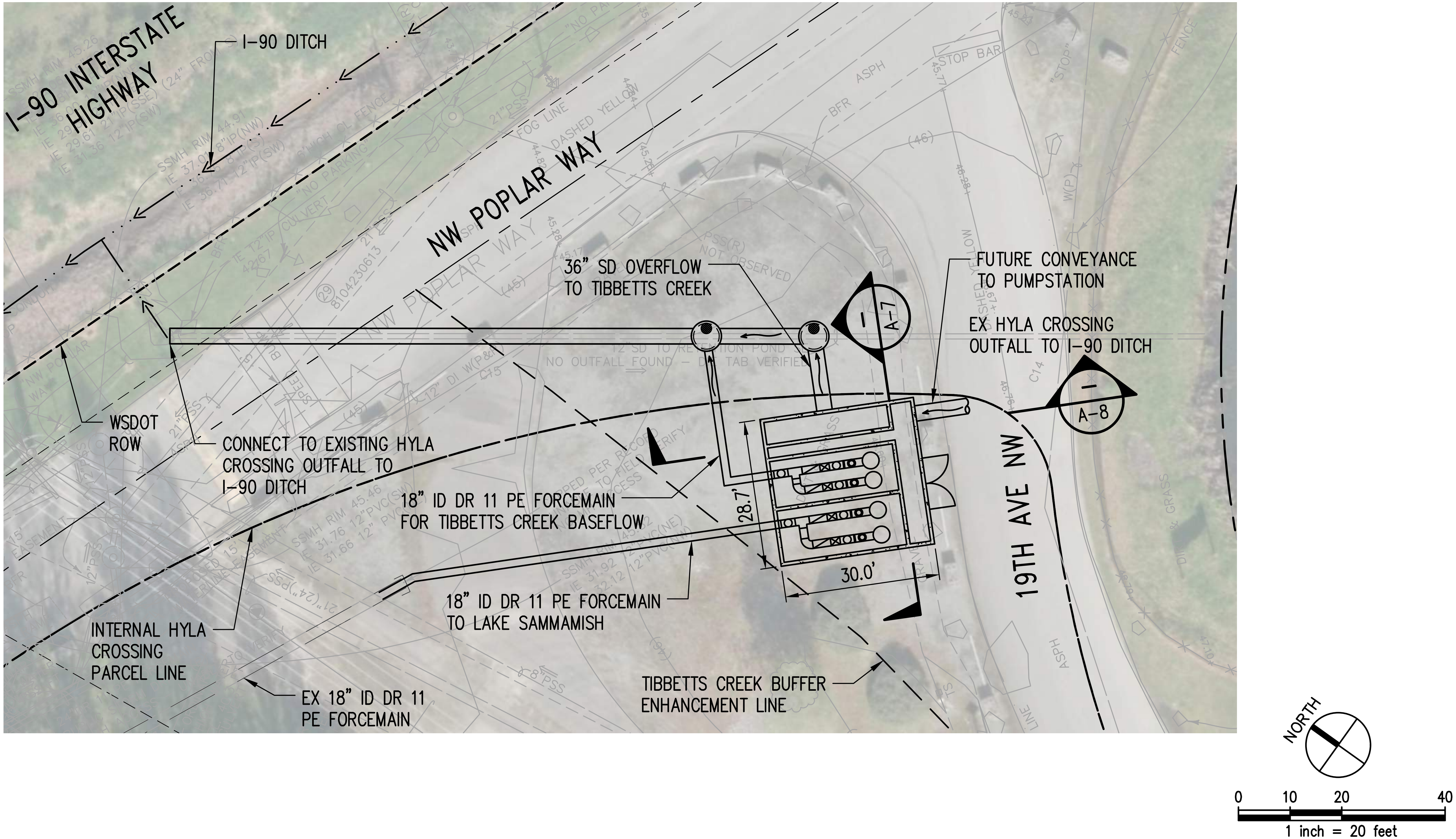

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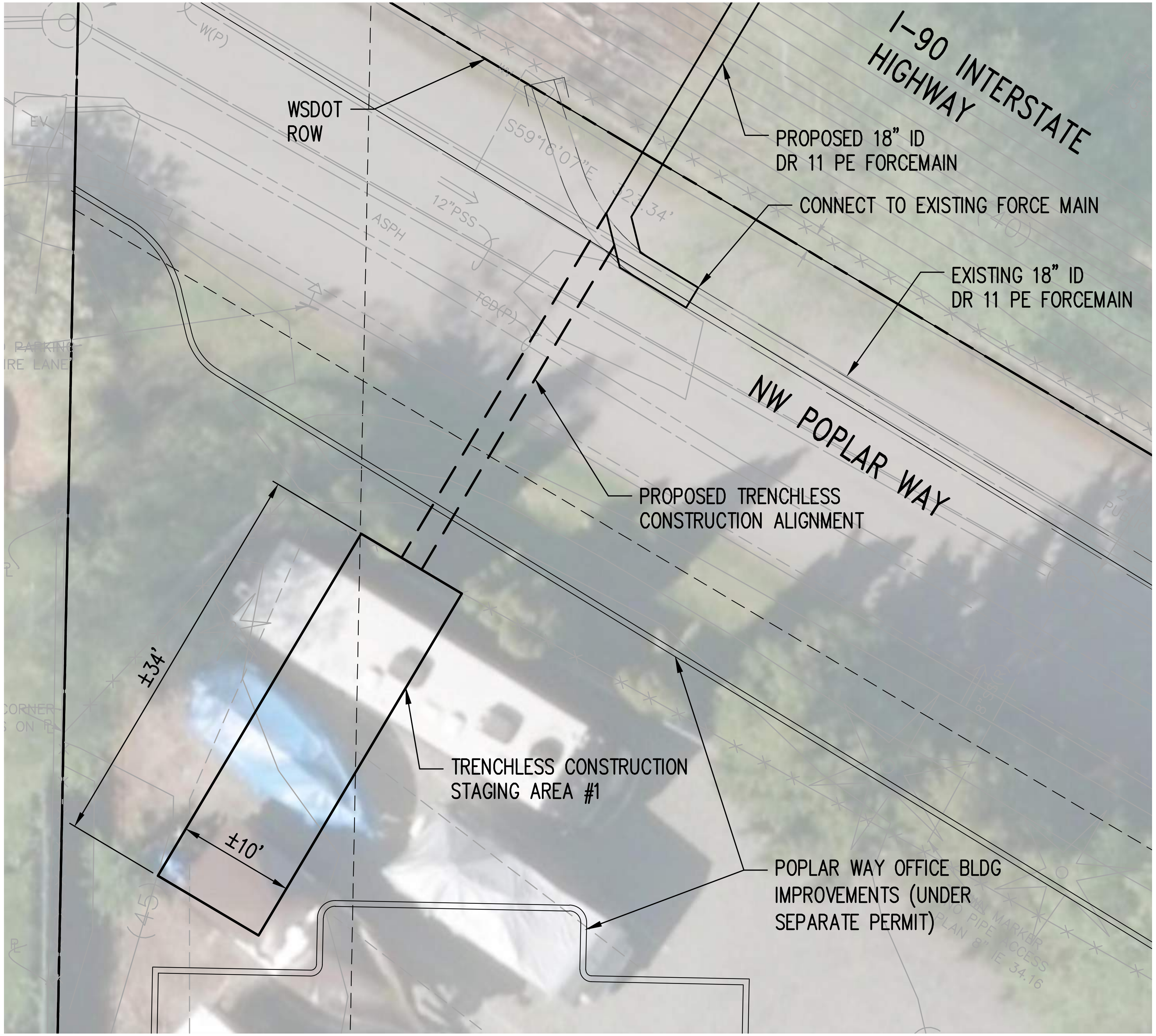

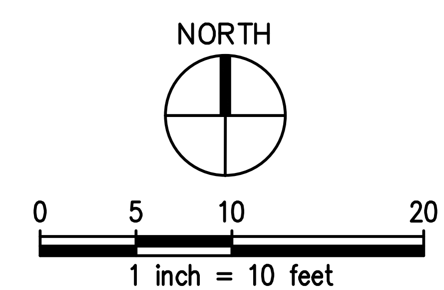

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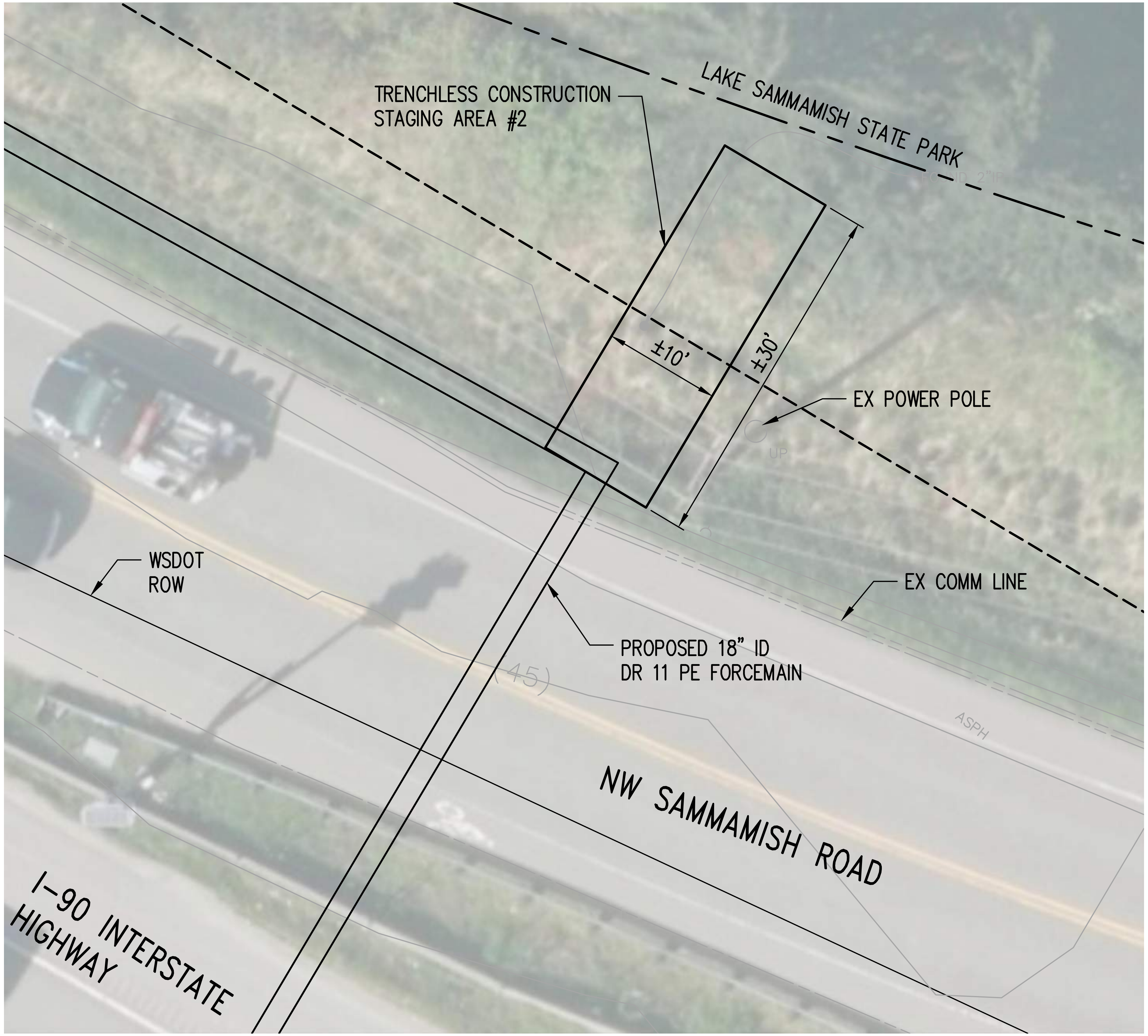

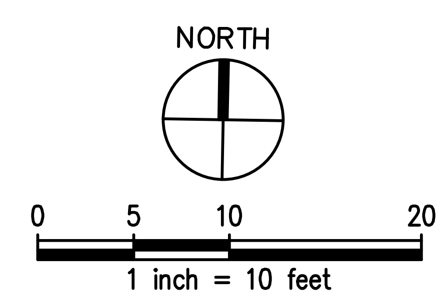

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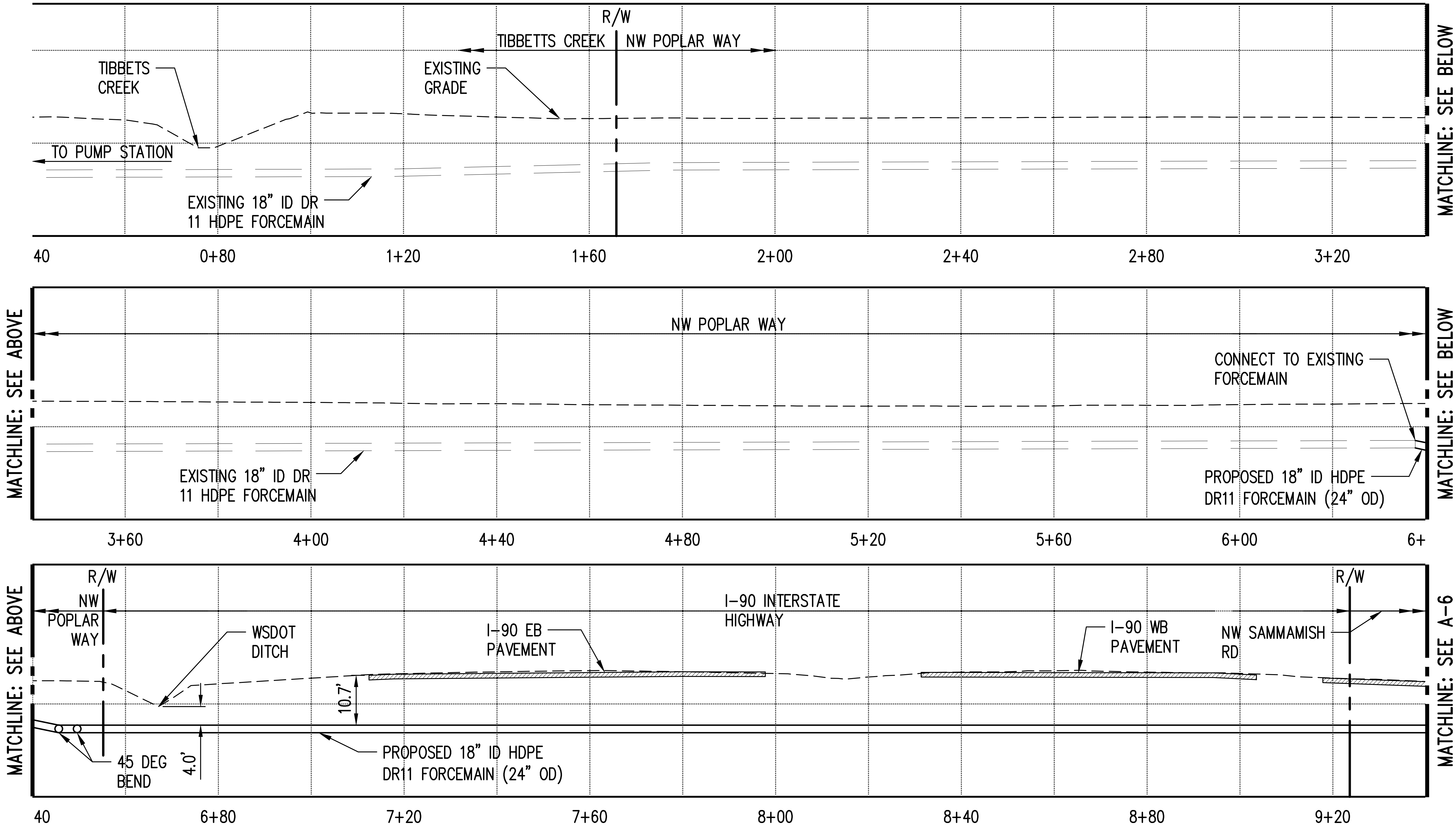

NOTE: PROFILE SHOWN IS SUBJECT TO CHANGE BASED ON SOIL CONDITIONS AND TRENCHLESS CONSTRUCTION METHOD FOR I-90 CROSSING.

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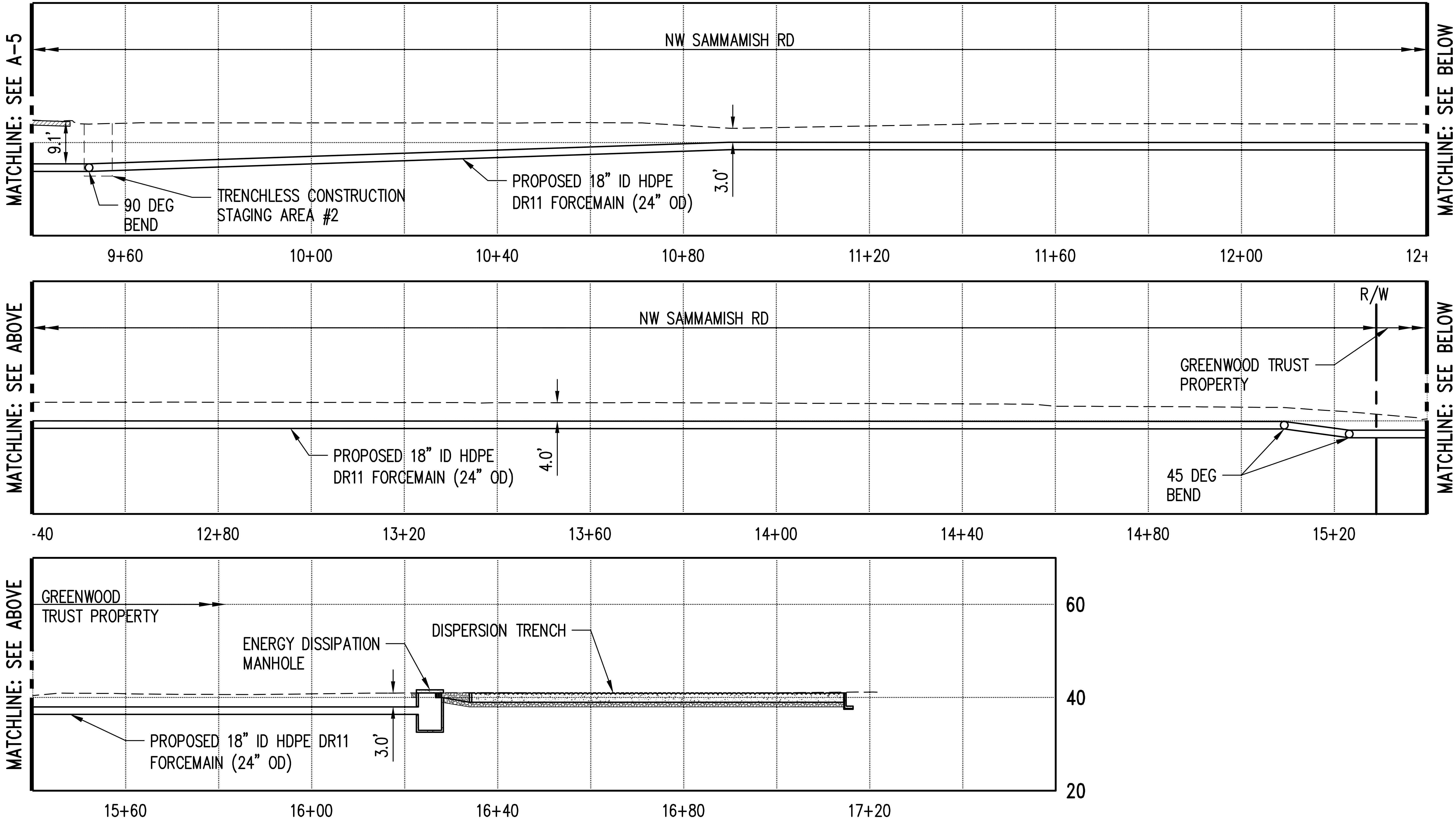

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Project Title	Drawing Title	A-6
HYLA CROSSING DIRECT LAKE DISCHARGE	FORCEMAIN PROFILE #2	Scale: 1" = 20'
Client: ROWLEY PROPERTIES INC.	kpff 1601 5th Avenue, Suite 1600 Seattle, WA 98101 206.622.5822 www.kpff.com	Date: NOV 2018 / Drawn/Ck'd By: CM/DY/CB

Nov 30, 2018 – 10:58am DaneY Z:\1800001-1800999\1800530 Hyla Crossing Direct Lake Discharge\CADD\Exhibits\2018-11-07 TIR Figure\Full Site Exhibit – HCDLD.dwg
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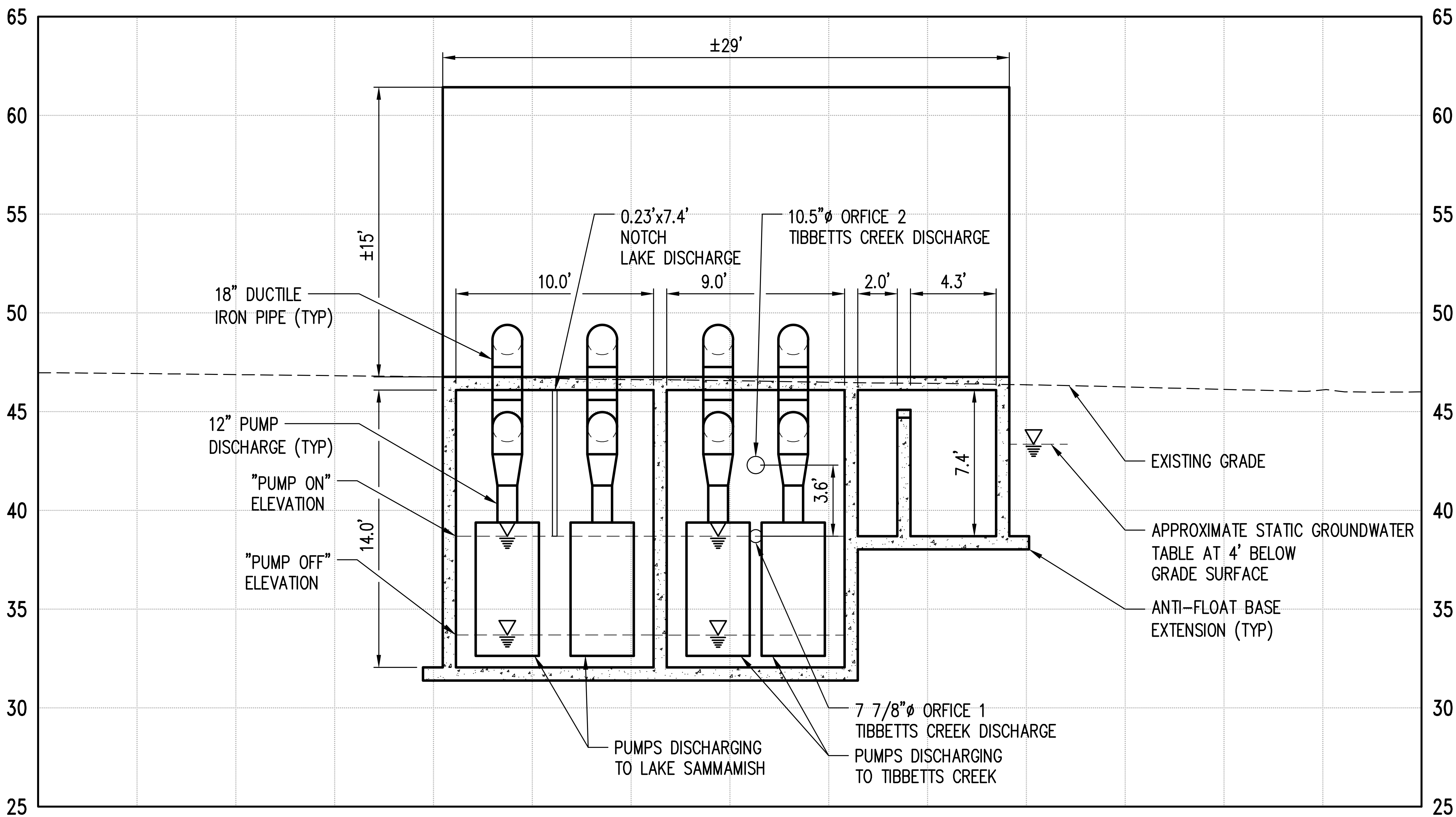
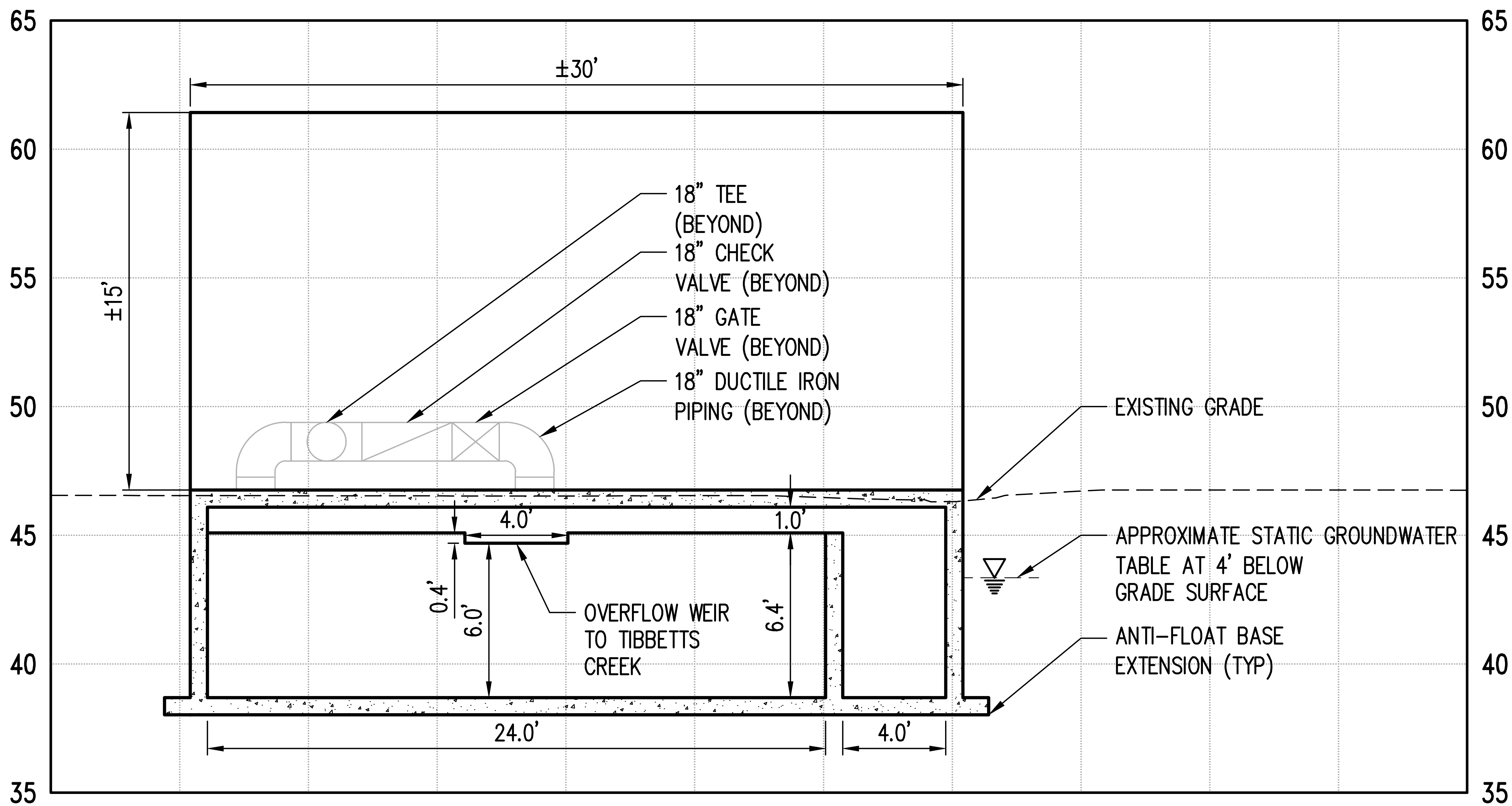


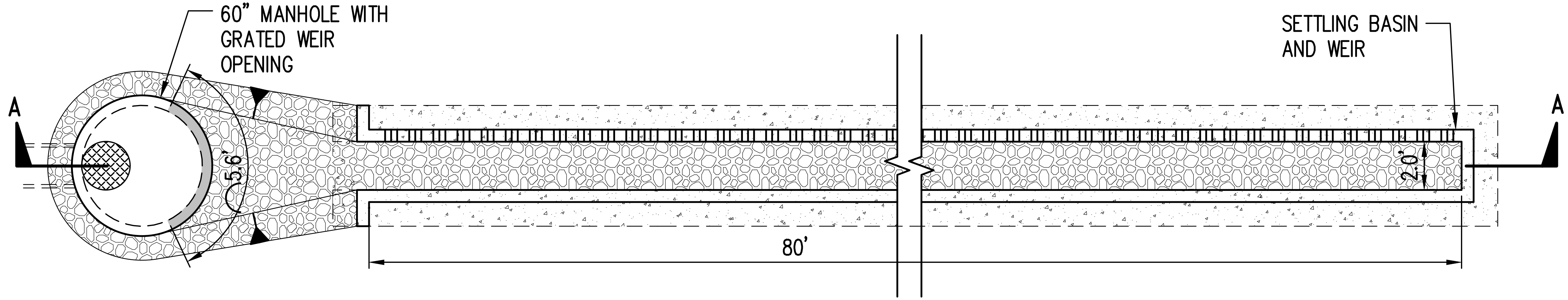
Project Title	Drawing Title	A-7
HYLA CROSSING DIRECT LAKE DISCHARGE	PUMP STATION SECTION	Scale: 1" = 5'
Client: ROWLEY PROPERTIES INC.	kpff 1601 5th Avenue, Suite 1600 Seattle, WA 98101 206.622.5822 www.kpff.com	Date: NOV 2018 — Drawn/Ck'd By: CM/DY/CB

Nov 30, 2018 - 2:23pm chrisb Z:\1800001-1800999\1800530 Hyla Crossing Direct Lake Discharge\CADD\Exhibits\2018-11-07 TIR Figure\PUMP STATION.dwg
Xref Filename: \ X-HCPSD-SP \ X-HCPSD-SV \ TITLE BLOCK\

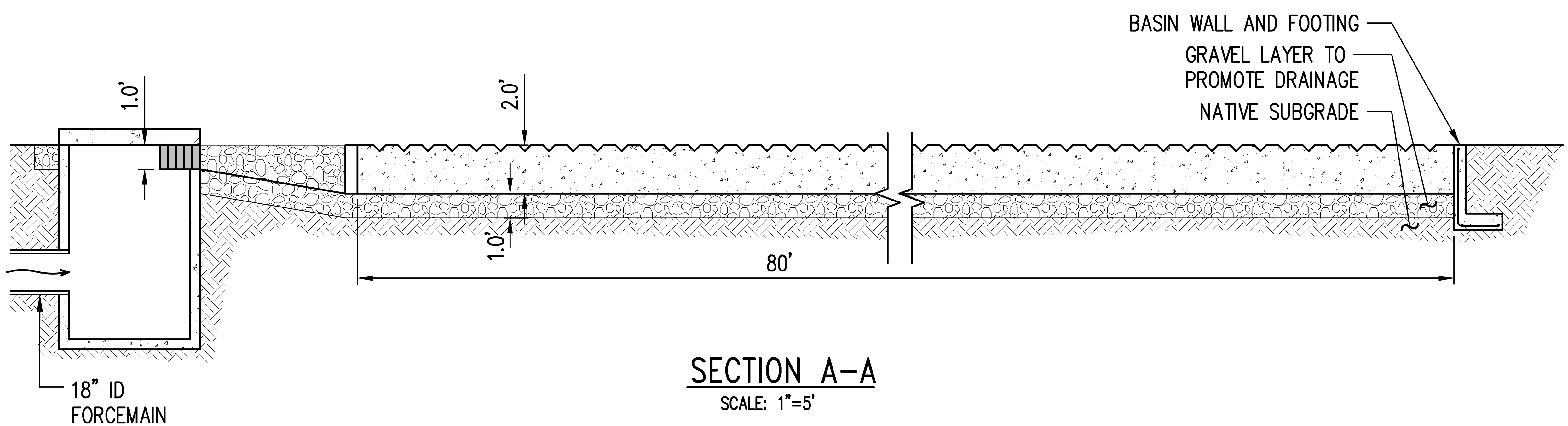


Project Title HYLA CROSSING DIRECT LAKE DISCHARGE	Drawing Title PUMP STATION SECTION	A-8
		Scale 1" = 5'
Client ROWLEY PROPERTIES INC.	kpff 1601 5th Avenue, Suite 1600 Seattle, WA 98101 206.622.5822 www.kpff.com	Date NOV 2018
		Drawn/Ck'd By CM/DY/CB

Nov 30, 2018 – 9:59am DoneY Z:\1800001-1800999\1800530 Hyla Crossing Direct Lake Discharge\CADD\Exhibits\2018-11-07 TIR Figure\PUMP STATION – Weir Section.dwg
Xref Filename: \ X-HCPSD-SP \ X-HCPSD-SV \ TITLE BLOCK\

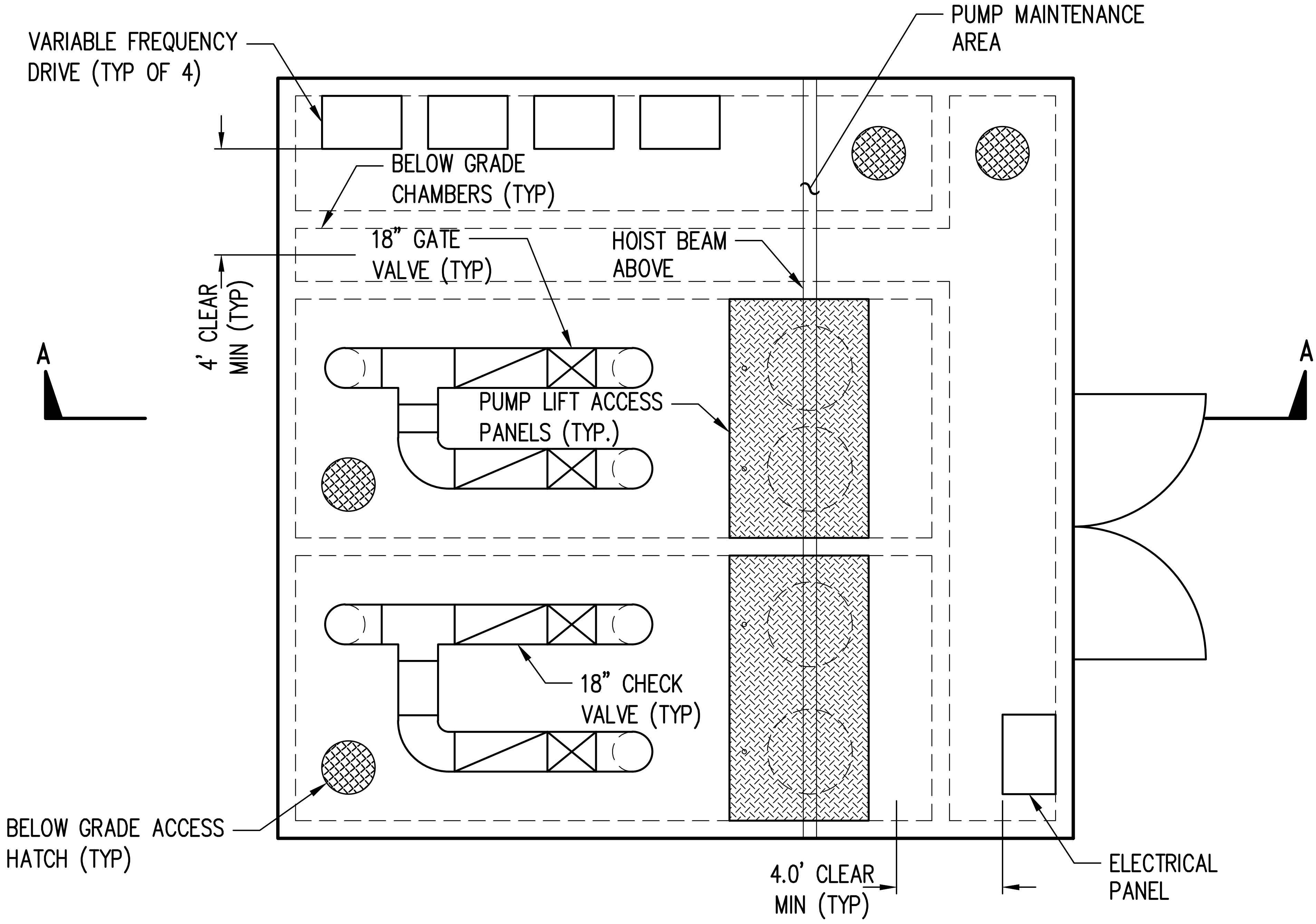


PLAN
SCALE: 1"=5'

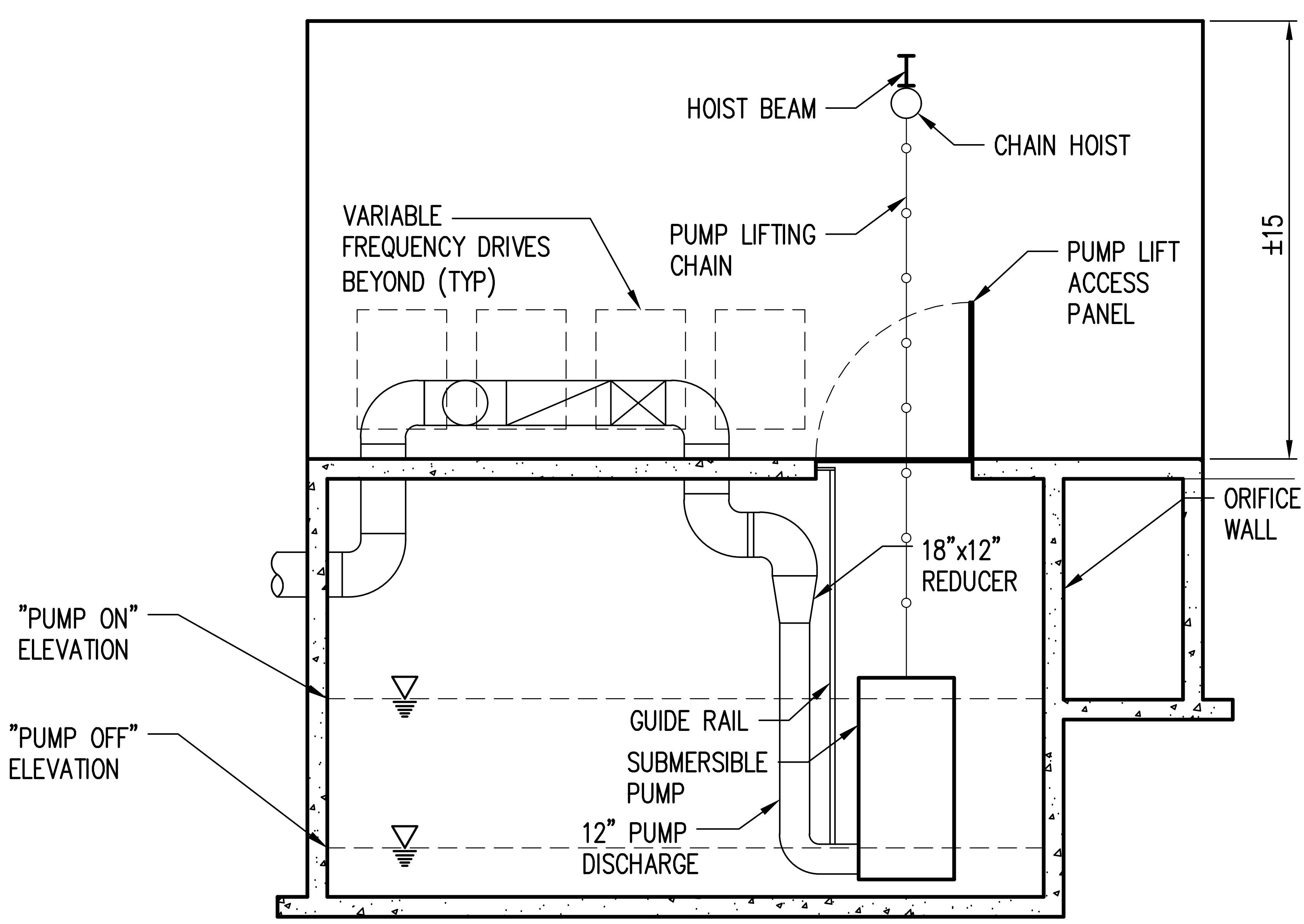


SECTION A-A
SCALE: 1"=5'

HYLA CROSSING DIRECT LAKE DISCHARGE	Drawing Title DISPERSION TRENCH DETAILS	A-9
		Scale: AS NOTED
ROWLEY PROPERTIES INC.	kpff 1601 5th Avenue, Suite 1600 Seattle, WA 98101 206.622.5822 www.kpff.com	Date: NOV 2018 / Drawn/Ck'd By: CM/DY/CB



PLAN
SCALE: 1"=5'



SECTION A-A
SCALE: 1"=5'

Project Title	Drawing Title	
HYLA CROSSING DIRECT LAKE DISCHARGE	PUMP STATION LAYOUT	A-10
		Scale: 1" = 5'
Client: ROWLEY PROPERTIES INC.	kpff 1601 5th Avenue, Suite 1600 Seattle, WA 98101 206.622.5822 www.kpff.com	Date: NOV 2018 / Drawn/Ck'd By: CM/DY/CB

Appendix B

Worksheets, Calculations, and Correspondence

Chris Borzio

From: Doug Schlepp [DougS@issaquahwa.gov]
Sent: Wednesday, October 14, 2015 1:34 PM
To: Kristi Tripple
Cc: Erik Svege; Kerry Ritland
Subject: KPFF Storm Technical Memo dated 9/9/15

Kristie,
Upon review of the above referenced memo the following design recommendations for the potential pump stations have been found to be consistent with the identified codes and standards (Rowley MDP 2011, COI 2011 Addendum to 2009 KCSWDM and 2009 KCSWDM):

- Level 2 Flow Control
- Overflow in excess of above flows discharged to Tibbets Creek (consistent with standard detention)

All other elements or recommendation of the memo are guided by the above or are discretionary and don't require acknowledgement. Further construction activities in NW Poplar will be governed by future Site Work permits and or easement conditions.

CITY OF ISSAQUAH WASHINGTON

Doug Schlepp P.E. | **DSD Consultant - RH2** | T: 425-837-3432 | Issaquah, WA - Official Website

TECHNICAL INFORMATION REPORT (TIR) WORKSHEET

Part 1 PROJECT OWNER AND PROJECT ENGINEER

Project Owner Kristi Tripple, Rowley Properties

Phone (425) 395-9583

Address 1595 NW Gilman Blvd, Suite 1

Issaquah, WA 98027

Project Engineer Martin F. Chase, PE

Company KPFF Consulting Engineers

Phone (206) 622-5822

Part 2 PROJECT LOCATION AND DESCRIPTION

Project Name Hyla Crossing Pumped Stormwater Discharge

DDES Permit # TBD

Location Township 24N

Range 6E

Section 20

Site Address N/A

Part 3 TYPE OF PERMIT APPLICATION

- ☐ Landuse Services
  Subdivison / Short Subd. / UPD
- ☑ Building Services
  M/F / Commerical / SFR
- ☑ Clearing and Grading
- ☐ Right-of-Way Use
- ☐ Other ______

Part 4 OTHER REVIEWS AND PERMITS

- ☑ DFW HPA
- ☐ COE 404
- ☐ DOE Dam Safety
- ☐ FEMA Floodplain
- ☑ COE Wetlands
- ☑ Other See Section 7
- ☐ Shoreline Management
- ☐ Structural Rockery/Vault/______
- ☐ ESA Section 7

Part 5 PLAN AND REPORT INFORMATION

Technical Information Report

Type of Drainage Review (circle): Full / Targeted / Large Site

Date (include revision dates): November 2018

Date of Final: TBD

Site Improvement Plan (Engr. Plans)

Type (circle one): Full / Modified / Small Site

Date (include revision dates): TBD

Date of Final: TBD

Part 6 ADJUSTMENT APPROVALS

Type (circle one): Standard / Complex / Preapplication / Experimental / Blanket

Description: (include conditions in TIR Section 2)

Date of Approval: ______

TECHNICAL INFORMATION REPORT (TIR) WORKSHEET

Part 7 MONITORING REQUIREMENTS

Monitoring Required: Yes / No

Start Date: ____________________

Completion Date: ____________________

Describe: ____________________

Part 8 SITE COMMUNITY AND DRAINAGE BASIN

Community Plan : ____________________
Special District Overlays: ____________________

Drainage Basin: Tibbetts Creek
Stormwater Requirements: ____________________

Part 9 ONSITE AND ADJACENT SENSITIVE AREAS

- ☑ River/Stream Tibbetts Creek
- ☑ Lake Lake Sammamish
- ☑ Wetlands COI Greenwood Property
- ☐ Closed Depression __________
- ☐ Floodplain __________
- ☐ Other __________
- ☐ Steep Slope __________
- ☐ Erosion Hazard __________
- ☐ Landslide Hazard __________
- ☐ Coal Mine Hazard __________
- ☐ Seismic Hazard __________
- ☐ Habitat Protection __________
- ☐ __________

Part 10 SOILS

Soil Type	Slopes	Erosion Potential
Seasonally Saturated	Gentle	Low

- ☑ High Groundwater Table (within 5 feet)
- ☐ Other __________
- ☐ Sole Source Aquifer
- ☐ Seeps/Springs

- ☐ Additional Sheets Attached

TECHNICAL INFORMATION REPORT (TIR) WORKSHEET

Part 11 DRAINAGE DESIGN LIMITATIONS	
REFERENCE	LIMITATION / SITE CONSTRAINT
☐ Core 2 – Offsite Analysis	
☑ Sensitive/Critical Areas	COI Greenwood Property Wetland
☐ SEPA	
☐ Other	
☐	
☐ Additional Sheets Attached	

Part 12 TIR SUMMARY SHEET	(provide one TIR Summary Sheet per Threshold Discharge Area)
Threshold Discharge Area: (name or description)	TDA #1
Core Requirements (all 8 apply)	
Discharge at Natural Location	Number of Natural Discharge Locations: 1
Offsite Analysis	Level: $\boxed{1}$ / 2 / 3 dated: July 2010
Flow Control (incl. facility summary sheet)	Level: 1 / $\boxed{2}$ / 3 or Exemption Number ____________ Small Site BMPs
Conveyance System	Spill containment located at: N/A
Erosion and Sediment Control	ESC Site Supervisor: Contact Phone: TBD After Hours Phone:
Maintenance and Operation	Responsibility: Private / $\boxed{\text{Public}}$ If Private, Maintenance Log Required: Yes / No
Financial Guarantees and Liability	Provided: $\boxed{\text{Yes}}$ / No
Water Quality (include facility summary sheet)	Type: Basic / $\boxed{\text{Sens. Lake}}$ / Enhanced Basicm / Bog or Exemption No. ____________ Landscape Management Plan: Yes / No
Special Requirements (as applicable)	
Area Specific Drainage Requirements	Type: CDA / SDO / $\boxed{\text{MDP}}$ / BP / LMP / Shared Fac. / None Name: Rowley Center and Hyla Crossing
Floodplain/Floodway Delineation	Type: Major / Minor / Exemption / $\boxed{\text{None}}$ 100-year Base Flood Elevation (or range): ____________ Datum:
Flood Protection Facilities	Describe: N/A
Source Control (comm./industrial landuse)	Describe landuse: N/A Describe any structural controls: N/A

TECHNICAL INFORMATION REPORT (TIR) WORKSHEET

Part 12 TIR SUMMARY SHEET	(provide one TIR Summary Sheet per Threshold Discharge Area)
Threshold Discharge Area: (name or description)	TDA #3
Core Requirements (all 8 apply)	
Discharge at Natural Location	Number of Natural Discharge Locations: 1
Offsite Analysis	Level: $\boxed{1}$ / 2 / 3 dated: July 2010
Flow Control (incl. facility summary sheet)	Level: 1 / $\boxed{2}$ / 3 or Exemption Number ______ Small Site BMPs ______
Conveyance System	Spill containment located at: N/A
Erosion and Sediment Control	ESC Site Supervisor: Contact Phone: TBD After Hours Phone:
Maintenance and Operation	Responsibility: Private / $\boxed{\text{Public}}$ If Private, Maintenance Log Required: Yes / No
Financial Guarantees and Liability	Provided: $\boxed{\text{Yes}}$ / No
Water Quality (include facility summary sheet)	Type: Basic / $\boxed{\text{Sens. Lake}}$ / Enhanced Basicm / Bog or Exemption No. ______ Landscape Management Plan: Yes / No
Special Requirements (as applicable)	
Area Specific Drainage Requirements	Type: CDA / SDO / $\boxed{\text{MDP}}$ / BP / LMP / Shared Fac. / None Name: Rowley Center and Hyla Crossing
Floodplain/Floodway Delineation	Type: Major / Minor / Exemption / $\boxed{\text{None}}$ 100-year Base Flood Elevation (or range): ______ Datum:
Flood Protection Facilities	Describe: N/A
Source Control (comm./industrial landuse)	Describe landuse: N/A Describe any structural controls: N/A

TECHNICAL INFORMATION REPORT (TIR) WORKSHEET

Oil Control	High-use Site: Yes / **No** Treatment BMP: ________ Maintenance Agreement: Yes / **No** with whom? ________
Other Drainage Structures	
Describe:	

Part 13 EROSION AND SEDIMENT CONTROL REQUIREMENTS	
MINIMUM ESC REQUIREMENTS DURING CONSTRUCTION	MINIMUM ESC REQUIREMENTS AFTER CONSTRUCTION
☑ Clearing Limits	☑ Stabilize Exposed Surfaces
☑ Cover Measures	☑ Remove and Restore Temporary ESC Facilities
☑ Perimeter Protection	☑ Clean and Remove All Silt and Debris, Ensure Operation of Permanent Facilities
☑ Traffic Area Stabilization	☐ Flag Limits of SAO and open space preservation areas
☑ Sediment Retention	☐ Other ________
☑ Surface Water Collection	
☑ Dewatering Control	
☑ Dust Control	
☐ Flow Control	

Part 14 STORMWATER FACILITY DESCRIPTIONS (Note: Include Facility Summary and Sketch)

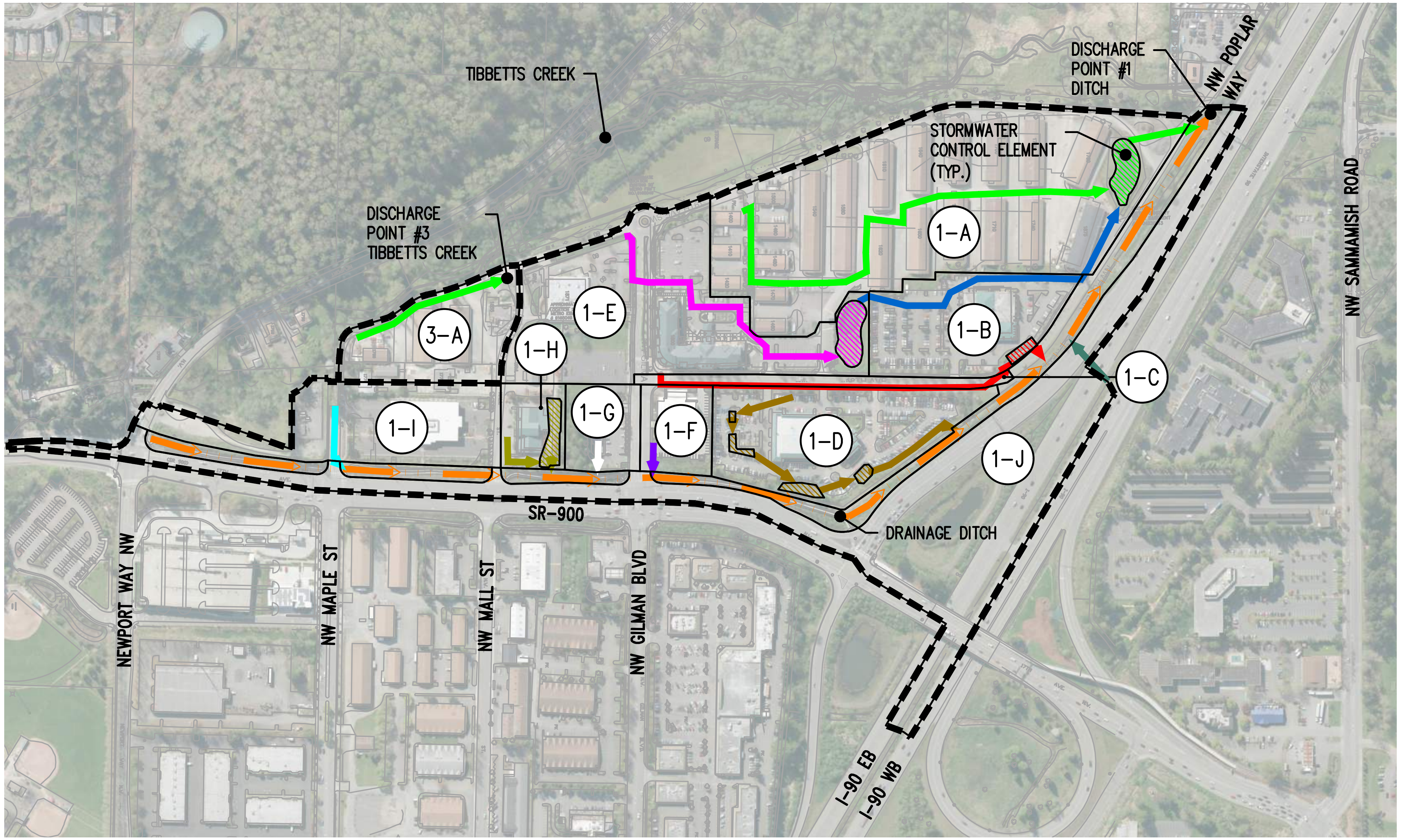
Flow Control	Type/Description	Water Quality	Type/Description
☐ Detention	________	☐ Biofiltration	________
☐ Infiltration	________	☐ Wetpool	________
☐ Regional Facility	________	☐ Media Filtration	________
☐ Shared Facility	________	☐ Oil Control	________
☐ Flow Control BMPs	________	☐ Spill Control	________
☑ Other	See description below	☐ Flow Control BMPs	________
		☐ Other	________

Pump Station directs historic base flows and developed flood flows to Tibbetts Creek according to Level 2 Flow Control. All other flows are pumped to Lake Sammamish in lieu of providing detention storage.

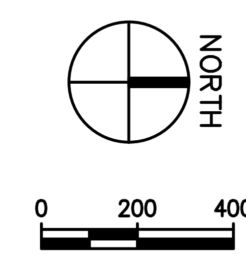
TECHNICAL INFORMATION REPORT (TIR) WORKSHEET

Part 15 EASEMENTS/TRACTS	Part 16 STRUCTURAL ANALYSIS
☐ Drainage Easement	☐ Cast in Place Vault
☐ Covenant	☐ Retaining Wall
☐ Native Growth Protection Covenant	☐ Rockery > 4' High
☐ Tract	☐ Structural on Steep Slope
☐ Other	☑ Other Pump Station structure

Part 17 SIGNATURE OF PROFESSIONAL ENGINEER
I, or a civil engineer under my supervision, have visited the site. Actual site conditions as observed were incorporated into this worksheet and the attached Technical Information Report. To the best of my knowledge the information provided here is accurate.
Chris Borzio, PE
Signed/Date



	SUBBASIN	DISCHARGE LOCATION
	HYLA CROSSING	
	1-A	1-A WETPOND TO DITCH
	1-B	1-A WETPOND TO DITCH
	1-C	DITCH
	1-D	DITCH
	1-E	1-E WETPOND TO 1-A WETPOND TO DITCH
	1-F	DITCH
	1-G	DITCH
	1-H	1-H WETPOND TO DITCH
	1-I	DITCH
	1-J	DITCH
	1-DITCH	



Project Title
HYLA CROSSING DIRECT LAKE DISCHARGE

Client
ROWLEY PROPERTIES INC.

Drawing Title
EXISTING SUB-BASIN CONNECTIVITY

kpff
1601 5th Avenue, Suite 1600
Seattle, WA 98101
206.622.5822
www.kpff.com

B-1

Scale
AS DRAWN

Date
NOV 2018

Drawn/Ck'd By
CM/DY/CB

Nov 30, 2018 - 1:09pm chrisb Z:\1800001-1800999\1800530 Hyla Crossing Direct Lake Discharge\CADD\Exhibits\2018-11-07 TIR Figure\EX CONDITIONS.dwg
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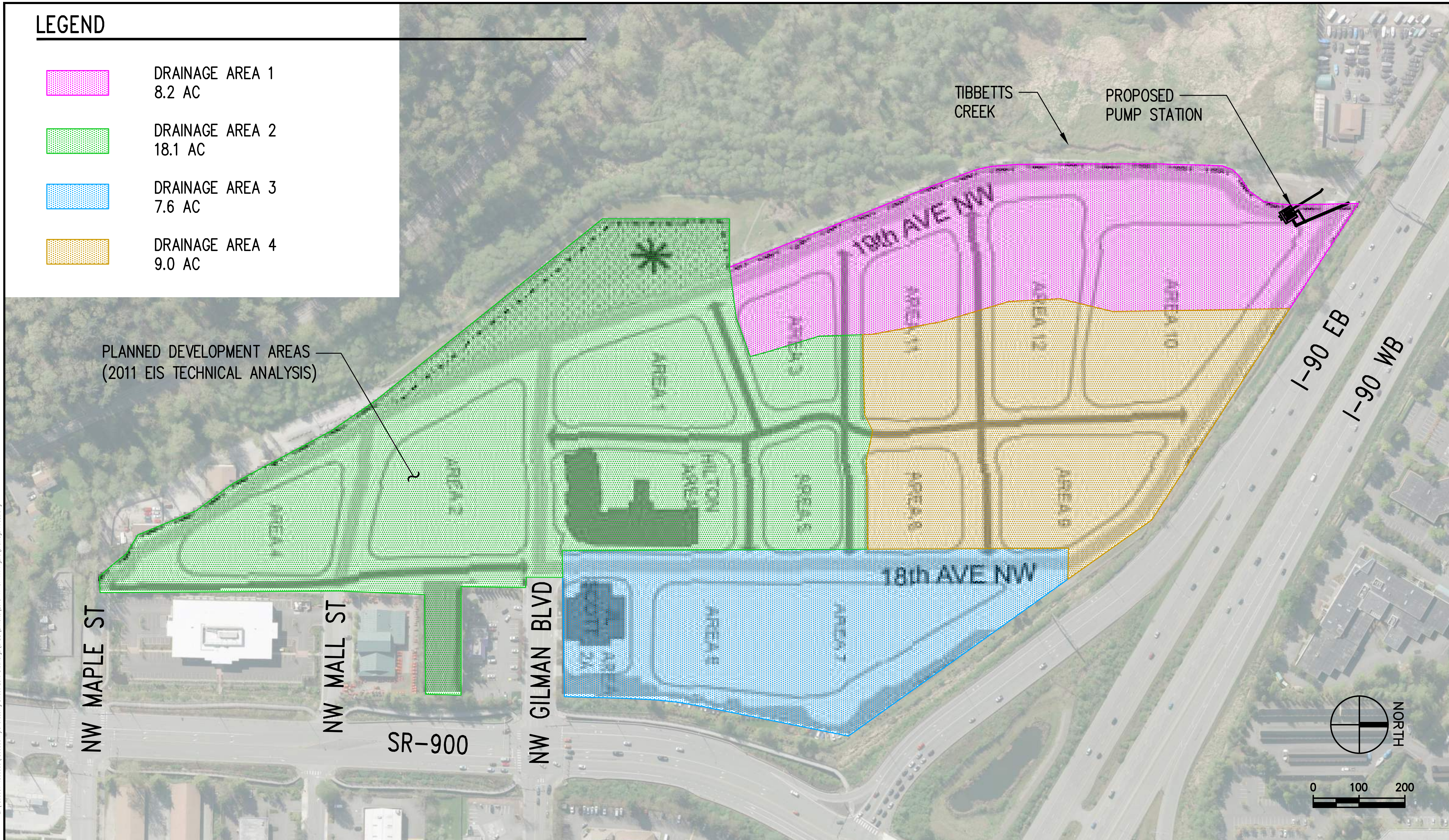


Nov 30, 2018 – 1:10pm chrisb Z:\1800001-1800999\1800530 Hyla Crossing Direct Lake Discharge\CADD\Exhibits\2018-11-07 TIR Figure\Drainage Areas.dwg

Project Title: HYLA CROSSING PUMPED STORMWATER DISCHARGE	Drawing Title: DRAINAGE BASINS	B-2
		Scale: AS DRAWN
Client: ROWLEY PROPERTIES	kpff 1601 5th Avenue, Suite 1600 Seattle, WA 98101 206.622.5822 www.kpff.com	Date: NOV 2018 / Drawn/Ck'd By: CB/MFC

WWHM2012

PROJECT REPORT

General Model Information

Project Name:	Detention Vault 1-hour
Site Name:	
Site Address:	
City:	
Report Date:	11/13/2018
Gage:	Seatac
Data Start:	1948/10/01
Data End:	2009/09/30
Timestep:	Hourly
Precip Scale:	1.33
Version Date:	2015/11/13
Version:	4.2.11

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year

Landuse Basin Data
Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
SAT, Forest, Flat	8.2
Pervious Total	8.2
Impervious Land Use	acre
Impervious Total	0
Basin Total	8.2

Element Flows To:

Surface	Interflow	Groundwater

Basin 2

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
SAT, Forest, Flat	18.1
Pervious Total	18.1
Impervious Land Use	acre
Impervious Total	0
Basin Total	18.1

Element Flows To:

Surface	Interflow	Groundwater

Basin 3

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
SAT, Forest, Flat	7.6
Pervious Total	7.6
Impervious Land Use	acre
Impervious Total	0
Basin Total	7.6

Element Flows To:

Surface	Interflow	Groundwater

Basin 4

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
SAT, Forest, Flat	9
Pervious Total	9
Impervious Land Use	acre
Impervious Total	0
Basin Total	9

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
SAT, Forest, Flat	8.2
Pervious Total	8.2
Impervious Land Use	acre
Impervious Total	0
Basin Total	8.2

Element Flows To:

Surface	Interflow	Groundwater
Vault 1	Vault 1	

Basin 2

Bypass:	No	
GroundWater:	No	
Pervious Land Use	acre	
SAT, Forest, Flat	18.1	
Pervious Total	18.1	
Impervious Land Use	acre	
Impervious Total	0	
Basin Total	18.1	

Element Flows To:

Surface	Interflow	Groundwater
Vault 1	Vault 1	

Basin 3

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
SAT, Forest, Flat	7.6
Pervious Total	7.6
Impervious Land Use	acre
Impervious Total	0
Basin Total	7.6

Element Flows To:

Surface	Interflow	Groundwater
Vault 1	Vault 1	

Basin 4

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
SAT, Forest, Flat	9
Pervious Total	9
Impervious Land Use	acre
Impervious Total	0
Basin Total	9

Element Flows To:

Surface	Interflow	Groundwater
Vault 1	Vault 1	

Routing Elements
Predeveloped Routing

Mitigated Routing

Vault 1

Width: 120 ft.
Length: 300 ft.
Depth: 20 ft.
Discharge Structure
Riser Height: 6 ft.
Riser Diameter: 15.28 in.
Orifice 1 Diameter: 7.88 in. Elevation:0 ft.
Orifice 2 Diameter: 10.5 in. Elevation:3.6 ft.
Element Flows To:
Outlet 1 Outlet 2

15.28" DIA CORRESPONDS TO 4' LONG OVERFLOW WEIR TO CREEK

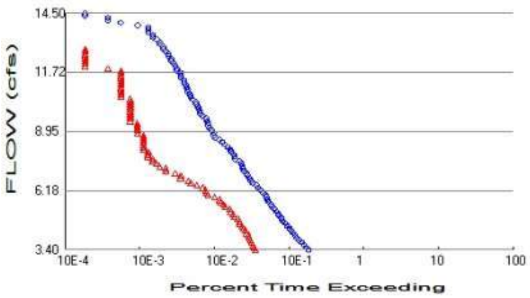
DISCHARGE TO TIBBETTS CREEK IS COPIED INTO THE PUMP STATION STAGE STORAGE DISCHARGE ELEMENT

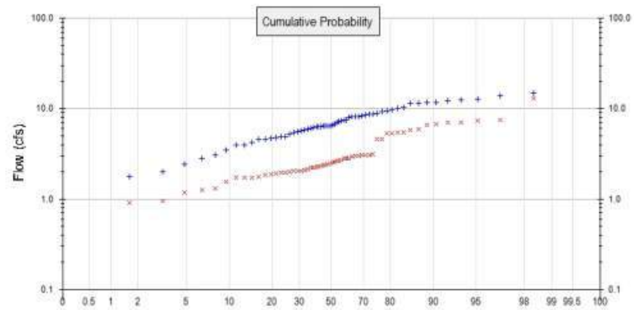
Vault Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.826	0.000	0.000	0.000
0.2222	0.826	0.183	0.794	0.000
0.4444	0.826	0.367	1.123	0.000
0.6667	0.826	0.551	1.375	0.000
0.8889	0.826	0.734	1.588	0.000
1.1111	0.826	0.918	1.776	0.000
1.3333	0.826	1.101	1.945	0.000
1.5556	0.826	1.285	2.101	0.000
1.7778	0.826	1.469	2.246	0.000
2.0000	0.826	1.652	2.383	0.000
2.2222	0.826	1.836	2.511	0.000
2.4444	0.826	2.020	2.634	0.000
2.6667	0.826	2.203	2.751	0.000
2.8889	0.826	2.387	2.864	0.000
3.1111	0.826	2.571	2.972	0.000
3.3333	0.826	2.754	3.076	0.000
3.5556	0.826	2.938	3.177	0.000
3.7778	0.826	3.122	4.536	0.000
4.0000	0.826	3.305	5.262	0.000
4.2222	0.826	3.489	5.822	0.000
4.4444	0.826	3.673	6.301	0.000
4.6667	0.826	3.856	6.730	0.000
4.8889	0.826	4.040	7.122	0.000
5.1111	0.826	4.224	7.487	0.000
5.3333	0.826	4.407	7.830	0.000
5.5556	0.826	4.591	8.155	0.000
5.7778	0.826	4.775	8.465	0.000
6.0000	0.826	4.958	8.762	0.000
6.2222	0.826	5.142	10.42	0.000
6.4444	0.826	5.326	12.53	0.000
6.6667	0.826	5.509	13.76	0.000
6.8889	0.826	5.693	14.66	0.000
7.1111	0.826	5.877	15.48	0.000
7.3333	0.826	6.060	16.24	0.000
7.5556	0.826	6.244	16.95	0.000
7.7778	0.826	6.427	17.62	0.000
8.0000	0.826	6.611	18.26	0.000
8.2222	0.826	6.795	18.87	0.000
8.4444	0.826	6.978	19.46	0.000

8.6667	0.826	7.162	20.03	0.000
8.8889	0.826	7.346	20.58	0.000
9.1111	0.826	7.529	21.11	0.000
9.3333	0.826	7.713	21.63	0.000
9.5556	0.826	7.897	22.13	0.000
9.7778	0.826	8.080	22.63	0.000
10.000	0.826	8.264	23.11	0.000
10.222	0.826	8.448	23.58	0.000
10.444	0.826	8.631	24.03	0.000
10.667	0.826	8.815	24.48	0.000
10.889	0.826	8.999	24.92	0.000
11.111	0.826	9.182	25.36	0.000
11.333	0.826	9.366	25.78	0.000
11.556	0.826	9.550	26.20	0.000
11.778	0.826	9.733	26.61	0.000
12.000	0.826	9.917	27.01	0.000
12.222	0.826	10.10	27.41	0.000
12.444	0.826	10.28	27.80	0.000
12.667	0.826	10.46	28.19	0.000
12.889	0.826	10.65	28.57	0.000
13.111	0.826	10.83	28.94	0.000
13.333	0.826	11.01	29.31	0.000
13.556	0.826	11.20	29.68	0.000
13.778	0.826	11.38	30.04	0.000
14.000	0.826	11.57	30.39	0.000
14.222	0.826	11.75	30.74	0.000
14.444	0.826	11.93	31.09	0.000
14.667	0.826	12.12	31.44	0.000
14.889	0.826	12.30	31.78	0.000
15.111	0.826	12.48	32.11	0.000
15.333	0.826	12.67	32.44	0.000
15.556	0.826	12.85	32.77	0.000
15.778	0.826	13.03	33.10	0.000
16.000	0.826	13.22	33.42	0.000
16.222	0.826	13.40	33.74	0.000
16.444	0.826	13.59	34.06	0.000
16.667	0.826	13.77	34.37	0.000
16.889	0.826	13.95	34.68	0.000
17.111	0.826	14.14	34.99	0.000
17.333	0.826	14.32	35.29	0.000
17.556	0.826	14.50	35.59	0.000
17.778	0.826	14.69	35.89	0.000
18.000	0.826	14.87	36.19	0.000
18.222	0.826	15.06	36.48	0.000
18.444	0.826	15.24	36.77	0.000
18.667	0.826	15.42	37.06	0.000
18.889	0.826	15.61	37.35	0.000
19.111	0.826	15.79	37.64	0.000
19.333	0.826	15.97	37.92	0.000
19.556	0.826	16.16	38.20	0.000
19.778	0.826	16.34	38.48	0.000
20.000	0.826	16.52	38.75	0.000
20.222	0.826	16.71	39.03	0.000
20.444	0.000	0.000	39.30	0.000

Analysis Results
POC 1





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 42.9
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 42.9
Total Impervious Area: 0

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	6.806202
5 year	9.777016
10 year	11.46781
25 year	13.311147
50 year	14.497567
100 year	15.546507

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	2.66359
5 year	4.379177
10 year	5.772988
25 year	7.850326
50 year	9.642372
100 year	11.656816

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1949	7.557	2.519
1950	11.377	3.086
1951	10.394	6.709
1952	5.616	2.054
1953	5.262	1.726
1954	7.129	2.253
1955	10.184	6.550
1956	8.215	2.979
1957	8.808	2.945
1958	6.332	2.803

1959	4.644	2.215
1960	8.390	5.374
1961	6.448	2.621
1962	3.079	1.255
1963	4.594	1.936
1964	7.920	2.242
1965	6.258	2.796
1966	6.428	2.040
1967	9.708	4.600
1968	5.880	2.106
1969	6.507	2.724
1970	7.419	2.297
1971	5.410	2.057
1972	11.793	5.943
1973	6.650	2.388
1974	4.649	1.765
1975	8.138	2.814
1976	6.371	2.355
1977	2.018	0.911
1978	5.783	1.840
1979	3.931	1.721
1980	4.190	1.978
1981	7.028	1.879
1982	12.152	5.806
1983	4.765	2.423
1984	5.644	2.342
1985	3.955	1.538
1986	8.622	5.399
1987	6.450	3.035
1988	2.820	1.318
1989	2.428	1.171
1990	14.013	7.486
1991	12.693	6.992
1992	6.142	2.153
1993	3.496	2.004
1994	1.757	0.863
1995	6.078	2.484
1996	11.778	7.409
1997	8.242	7.072
1998	4.886	1.958
1999	8.585	3.119
2000	9.181	2.662
2001	1.685	0.950
2002	8.680	4.618
2003	4.906	1.727
2004	12.429	2.585
2005	7.402	2.972
2006	6.795	3.047
2007	11.383	5.286
2008	14.650	12.902
2009	9.569	5.502

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	14.6501	12.9020
2	14.0130	7.4860
3	12.6932	7.4090

4	12.4290	7.0721
5	12.1519	6.9916
6	11.7925	6.7093
7	11.7778	6.5502
8	11.3834	5.9435
9	11.3771	5.8056
10	10.3943	5.5016
11	10.1842	5.3992
12	9.7082	5.3744
13	9.5694	5.2860
14	9.1807	4.6178
15	8.8085	4.5998
16	8.6801	3.1194
17	8.6223	3.0861
18	8.5849	3.0471
19	8.3899	3.0351
20	8.2421	2.9792
21	8.2149	2.9715
22	8.1383	2.9450
23	7.9198	2.8144
24	7.5572	2.8025
25	7.4192	2.7962
26	7.4023	2.7241
27	7.1289	2.6625
28	7.0283	2.6210
29	6.7953	2.5845
30	6.6503	2.5186
31	6.5071	2.4841
32	6.4497	2.4230
33	6.4483	2.3878
34	6.4281	2.3546
35	6.3709	2.3424
36	6.3321	2.2975
37	6.2578	2.2528
38	6.1420	2.2420
39	6.0780	2.2151
40	5.8798	2.1533
41	5.7833	2.1063
42	5.6444	2.0567
43	5.6160	2.0540
44	5.4103	2.0404
45	5.2625	2.0044
46	4.9063	1.9778
47	4.8859	1.9585
48	4.7649	1.9362
49	4.6489	1.8786
50	4.6439	1.8399
51	4.5944	1.7648
52	4.1897	1.7273
53	3.9549	1.7262
54	3.9311	1.7205
55	3.4958	1.5383
56	3.0790	1.3178
57	2.8198	1.2553
58	2.4278	1.1707
59	2.0178	0.9504
60	1.7567	0.9112
61	1.6854	0.8634

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
3.4031	978	190	19	Pass
3.5152	909	181	19	Pass
3.6272	850	175	20	Pass
3.7393	790	169	21	Pass
3.8514	731	164	22	Pass
3.9634	679	158	23	Pass
4.0755	643	154	23	Pass
4.1876	611	146	23	Pass
4.2996	570	139	24	Pass
4.4117	544	131	24	Pass
4.5238	503	126	25	Pass
4.6358	474	118	24	Pass
4.7479	448	116	25	Pass
4.8600	423	111	26	Pass
4.9720	404	98	24	Pass
5.0841	381	95	24	Pass
5.1961	362	89	24	Pass
5.3082	343	86	25	Pass
5.4203	320	75	23	Pass
5.5323	303	71	23	Pass
5.6444	284	66	23	Pass
5.7565	277	63	22	Pass
5.8685	269	54	20	Pass
5.9806	255	44	17	Pass
6.0927	238	42	17	Pass
6.2047	220	41	18	Pass
6.3168	205	38	18	Pass
6.4289	195	31	15	Pass
6.5409	174	26	14	Pass
6.6530	165	24	14	Pass
6.7651	157	19	12	Pass
6.8771	148	19	12	Pass
6.9892	143	16	11	Pass
7.1013	135	12	8	Pass
7.2133	129	12	9	Pass
7.3254	127	10	7	Pass
7.4375	122	9	7	Pass
7.5495	115	8	6	Pass
7.6616	102	8	7	Pass
7.7736	100	7	7	Pass
7.8857	97	7	7	Pass
7.9978	90	7	7	Pass
8.1098	87	6	6	Pass
8.2219	81	6	7	Pass
8.3340	75	6	8	Pass
8.4460	68	6	8	Pass
8.5581	62	6	9	Pass
8.6702	55	6	10	Pass
8.7822	53	6	11	Pass
8.8943	52	5	9	Pass
9.0064	49	5	10	Pass
9.1184	46	5	10	Pass
9.2305	44	5	11	Pass

9.3426	44	5	11	Pass
9.4546	43	4	9	Pass
9.5667	41	4	9	Pass
9.6788	37	4	10	Pass
9.7908	35	4	11	Pass
9.9029	34	4	11	Pass
10.0150	33	4	12	Pass
10.1270	32	4	12	Pass
10.2391	30	4	13	Pass
10.3512	30	4	13	Pass
10.4632	27	4	14	Pass
10.5753	26	3	11	Pass
10.6873	25	3	12	Pass
10.7994	24	3	12	Pass
10.9115	24	3	12	Pass
11.0235	23	3	13	Pass
11.1356	22	3	13	Pass
11.2477	21	3	14	Pass
11.3597	21	3	14	Pass
11.4718	19	3	15	Pass
11.5839	19	3	15	Pass
11.6959	19	3	15	Pass
11.8080	17	3	17	Pass
11.9201	17	2	11	Pass
12.0321	16	1	6	Pass
12.1442	15	1	6	Pass
12.2563	14	1	7	Pass
12.3683	14	1	7	Pass
12.4804	13	1	7	Pass
12.5925	13	1	7	Pass
12.7045	12	1	8	Pass
12.8166	11	1	9	Pass
12.9287	11	0	0	Pass
13.0407	10	0	0	Pass
13.1528	10	0	0	Pass
13.2648	9	0	0	Pass
13.3769	8	0	0	Pass
13.4890	8	0	0	Pass
13.6010	7	0	0	Pass
13.7131	7	0	0	Pass
13.8252	7	0	0	Pass
13.9372	5	0	0	Pass
14.0493	3	0	0	Pass
14.1614	2	0	0	Pass
14.2734	2	0	0	Pass
14.3855	1	0	0	Pass
14.4976	1	0	0	Pass

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	0 acre-feet
On-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.
Off-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.

LID Report

LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
Vault 1 POC	☐	2564.41			☐	0.00			
Total Volume Infiltrated		2564.41	0.00	0.00		0.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Failed

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

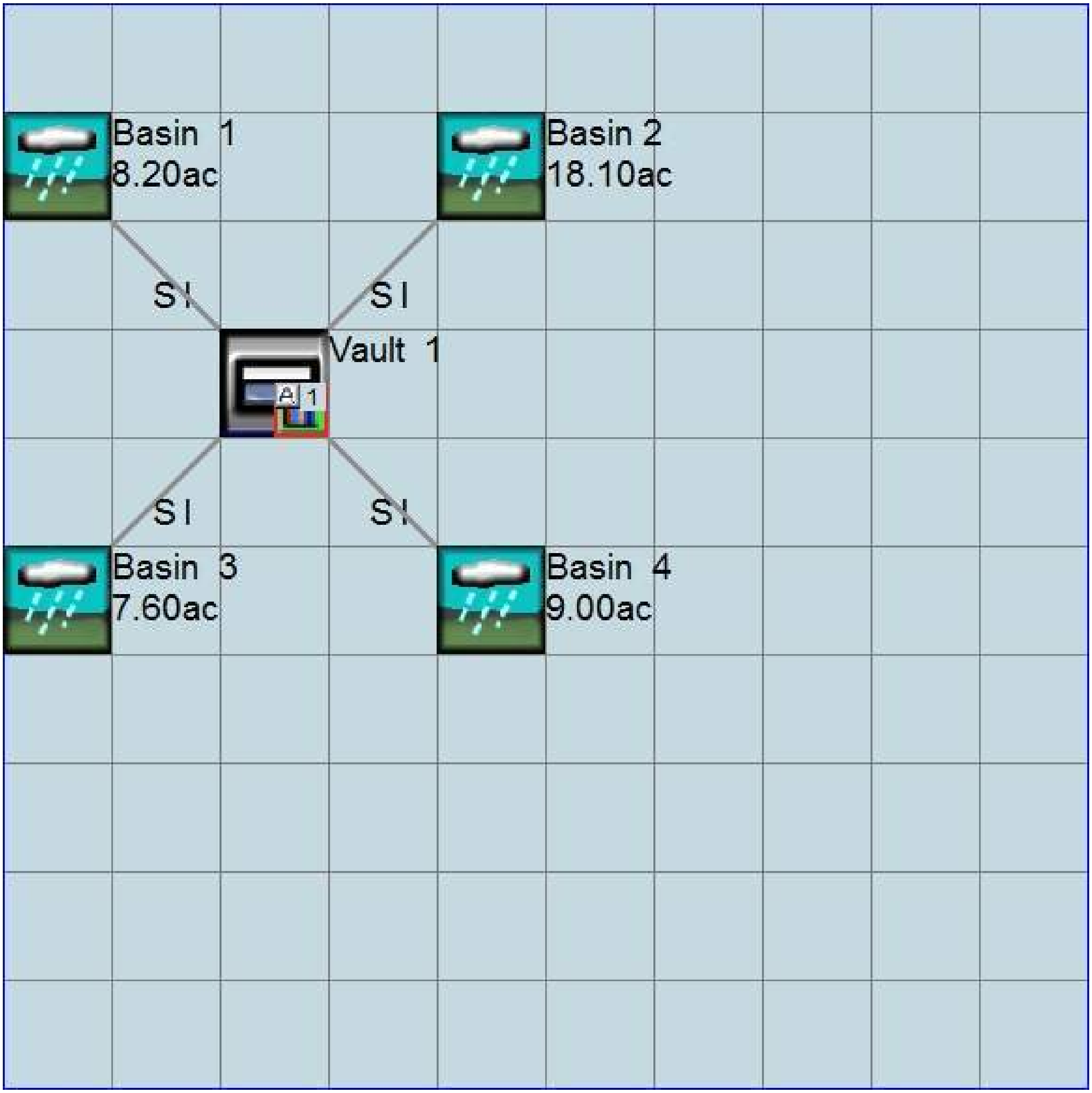
No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic

Mitigated Schematic



Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                             ***
WDM        26   Detention Vault 1-hour.wdm
MESSU      25   PreDetention Vault 1-hour.MES
           27   PreDetention Vault 1-hour.L61
           28   PreDetention Vault 1-hour.L62
           30   POCDetention Vault 1-hour1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:60
      PERLND      19
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Basin  1                    MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                            User  t-series Engl Metr ***
                                            in  out          ***
   19     SAT, Forest, Flat       1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   19         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   19         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO
```

```
  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   19         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   19            0         4         2       100     0.001       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   19            0         0        10         2         0         0       0.7
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                               ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   19           0.2         3       0.5         1       0.7       0.8
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
             ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   19            0         0         0         0       4.2         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                      in  out           ***
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
  END IWAT-STATE1
```

```
END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  19                         8.2     COPY   501     12
PERLND  19                         8.2     COPY   501     13
Basin 2***
PERLND  19                        18.1     COPY   501     12
PERLND  19                        18.1     COPY   501     13
Basin  3***
PERLND  19                         7.6     COPY   501     12
PERLND  19                         7.6     COPY   501     13
Basin  4***
PERLND  19                           9     COPY   501     12
PERLND  19                           9     COPY   501     13

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   12.1        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                           in  out                           ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ****************** PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                      ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                         ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
```

```
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1.333     SUM  PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.333     SUM  IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY   501 OUTPUT MEAN   1 1     12.1      WDM    501 FLOW     ENGL       REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                             ***
WDM        26   Detention Vault 1-hour.wdm
MESSU      25   MitDetention Vault 1-hour.MES
           27   MitDetention Vault 1-hour.L61
           28   MitDetention Vault 1-hour.L62
           30   POCDetention Vault 1-hour1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:60
      PERLND      19
      RCHRES       1
      COPY         1
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Vault  1                    MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                            User  t-series Engl Metr ***
                                             in  out           ***
   19      SAT, Forest, Flat       1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   19         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   19         0    0    4    0    0    0    0    0    0    0    0    0    1    9
```

```
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   19         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   19              0         4         2       100     0.001       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   19              0         0        10         2         0         0       0.7
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                               ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   19            0.2         3       0.5         1       0.7       0.8
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
              ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   19              0         0         0         0       4.2         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                     in  out            ***
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
```

```
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  19                         8.2     RCHRES   1      2
PERLND  19                         8.2     RCHRES   1      3
Basin 2***
PERLND  19                        18.1     RCHRES   1      2
PERLND  19                        18.1     RCHRES   1      3
Basin  3***
PERLND  19                         7.6     RCHRES   1      2
PERLND  19                         7.6     RCHRES   1      3
Basin  4***
PERLND  19                           9     RCHRES   1      2
PERLND  19                           9     RCHRES   1      3

******Routing******
PERLND  19                         8.2     COPY     1     12
PERLND  19                         8.2     COPY     1     13
PERLND  19                        18.1     COPY     1     12
PERLND  19                        18.1     COPY     1     13
PERLND  19                         7.6     COPY     1     12
PERLND  19                         7.6     COPY     1     13
PERLND  19                           9     COPY     1     12
PERLND  19                           9     COPY     1     13
RCHRES   1                           1     COPY   501     16
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   12.1        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                           in  out                           ***
    1     Vault  1               1    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
    1        1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ****************** PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
    1        4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                      ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
    1        0  1  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
```

```
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
    1            1      0.06       0.0       0.0       0.5       0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                         ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit       for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1          0          4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
  FTABLE      1
   92    4
     Depth      Area    Volume  Outflow1 Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.826446  0.000000  0.000000
  0.222222  0.826446  0.183655  0.794337
  0.444444  0.826446  0.367309  1.123362
  0.666667  0.826446  0.550964  1.375832
  0.888889  0.826446  0.734619  1.588674
  1.111111  0.826446  0.918274  1.776192
  1.333333  0.826446  1.101928  1.945721
  1.555556  0.826446  1.285583  2.101619
  1.777778  0.826446  1.469238  2.246725
  2.000000  0.826446  1.652893  2.383012
  2.222222  0.826446  1.836547  2.511915
  2.444444  0.826446  2.020202  2.634518
  2.666667  0.826446  2.203857  2.751665
  2.888889  0.826446  2.387511  2.864023
  3.111111  0.826446  2.571166  2.972138
  3.333333  0.826446  2.754821  3.076455
  3.555556  0.826446  2.938476  3.177349
  3.777778  0.826446  3.122130  4.536604
  4.000000  0.826446  3.305785  5.262289
  4.222222  0.826446  3.489440  5.822425
  4.444444  0.826446  3.673095  6.301689
  4.666667  0.826446  3.856749  6.730062
  4.888889  0.826446  4.040404  7.122377
  5.111111  0.826446  4.224059  7.487285
  5.333333  0.826446  4.407713  7.830373
  5.555556  0.826446  4.591368  8.155500
  5.777778  0.826446  4.775023  8.465477
  6.000000  0.826446  4.958678  8.762425
  6.222222  0.826446  5.142332  10.42180
  6.444444  0.826446  5.325987  12.53941
  6.666667  0.826446  5.509642  13.75967
  6.888889  0.826446  5.693297  14.66314
  7.111111  0.826446  5.876951  15.48251
  7.333333  0.826446  6.060606  16.24065
  7.555556  0.826446  6.244261  16.95130
  7.777778  0.826446  6.427916  17.62354
  8.000000  0.826446  6.611570  18.26377
  8.222222  0.826446  6.795225  18.87669
  8.444444  0.826446  6.978880  19.46592
  8.666667  0.826446  7.162534  20.03430
  8.888889  0.826446  7.346189  20.58411
  9.111111  0.826446  7.529844  21.11724
  9.333333  0.826446  7.713499  21.63524
  9.555556  0.826446  7.897153  22.13945
  9.777778  0.826446  8.080808  22.63100
  10.00000  0.826446  8.264463  23.11086
  10.22222  0.826446  8.448118  23.57990
```

```
  10.44444  0.826446  8.631772  24.03885
  10.66667  0.826446  8.815427  24.48840
  10.88889  0.826446  8.999082  24.92912
  11.11111  0.826446  9.182736  25.36155
  11.33333  0.826446  9.366391  25.78616
  11.55556  0.826446  9.550046  26.20339
  11.77778  0.826446  9.733701  26.61363
  12.00000  0.826446  9.917355  27.01723
  12.22222  0.826446  10.10101  27.41451
  12.44444  0.826446  10.28466  27.80579
  12.66667  0.826446  10.46832  28.19134
  12.88889  0.826446  10.65197  28.57141
  13.11111  0.826446  10.83563  28.94623
  13.33333  0.826446  11.01928  29.31603
  13.55556  0.826446  11.20294  29.68102
  13.77778  0.826446  11.38659  30.04137
  14.00000  0.826446  11.57025  30.39727
  14.22222  0.826446  11.75390  30.74888
  14.44444  0.826446  11.93756  31.09637
  14.66667  0.826446  12.12121  31.43987
  14.88889  0.826446  12.30487  31.77953
  15.11111  0.826446  12.48852  32.11547
  15.33333  0.826446  12.67218  32.44782
  15.55556  0.826446  12.85583  32.77669
  15.77778  0.826446  13.03949  33.10219
  16.00000  0.826446  13.22314  33.42444
  16.22222  0.826446  13.40680  33.74351
  16.44444  0.826446  13.59045  34.05951
  16.66667  0.826446  13.77410  34.37254
  16.88889  0.826446  13.95776  34.68266
  17.11111  0.826446  14.14141  34.98997
  17.33333  0.826446  14.32507  35.29453
  17.55556  0.826446  14.50872  35.59643
  17.77778  0.826446  14.69238  35.89574
  18.00000  0.826446  14.87603  36.19251
  18.22222  0.826446  15.05969  36.48682
  18.44444  0.826446  15.24334  36.77872
  18.66667  0.826446  15.42700  37.06828
  18.88889  0.826446  15.61065  37.35555
  19.11111  0.826446  15.79431  37.64059
  19.33333  0.826446  15.97796  37.92345
  19.55556  0.826446  16.16162  38.20417
  19.77778  0.826446  16.34527  38.48281
  20.00000  0.826446  16.52893  38.75942
  20.22222  0.826446  16.71258  39.03403
  END FTABLE  1
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1.333     SUM  PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.333     SUM  IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
RCHRES   1 HYDR   RO     1 1        1      WDM   1000 FLOW     ENGL      REPL
RCHRES   1 HYDR   STAGE  1 1        1      WDM   1001 STAG     ENGL      REPL
COPY     1 OUTPUT MEAN   1 1     12.1      WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1     12.1      WDM    801 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
```

```
  MASS-LINK        2
PERLND     PWATER SURO       0.083333      RCHRES          INFLOW IVOL
  END MASS-LINK    2

  MASS-LINK        3
PERLND     PWATER IFWO       0.083333      RCHRES          INFLOW IVOL
  END MASS-LINK    3

  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY            INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY            INPUT  MEAN
  END MASS-LINK   13

  MASS-LINK       16
RCHRES     ROFLOW                          COPY            INPUT  MEAN
  END MASS-LINK   16

END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

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1 - Hour

Flow Splitter Initial Bay Area

D =	96	IN
A =	50.27	SF
A =	0.001154	AC

Force Main Velocity

D =	19.37	IN
V =	5.13	FPS

Riser Height

6.00	FT

Creek Overflow Elev

6.40	FT

Overflow Capacity

50	CFS

Weir 1

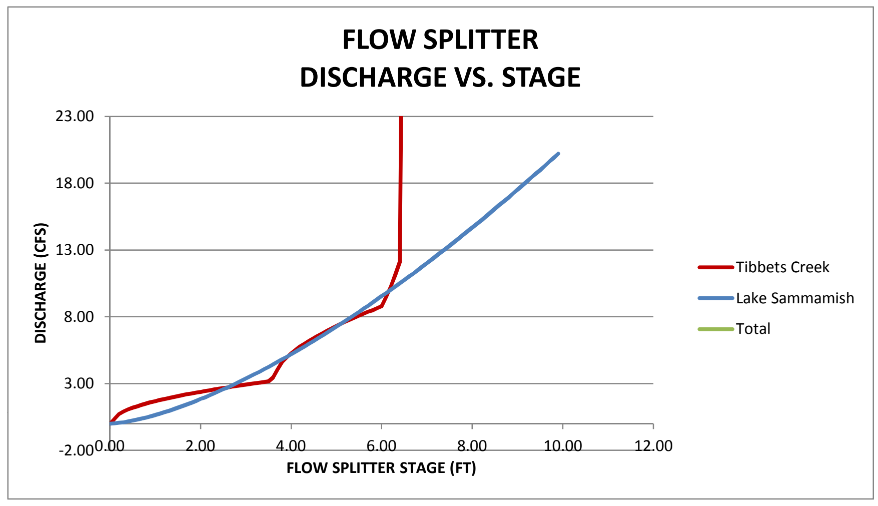
3	Crest EL =	0.00	FT
4	IE Out =	-10.00	FT
5	L =	0.23	FT
6	i =	2	
7	B_R =	-1.05	FT
8	0.8 L =	0.184	FT
9	H =	6.40	FT
10	P =	10	FT
11	C =	3.526	FT
12	Q_W =	10.50	CFS

Pumped Flow at Return Periods

Return Event (Year)	Stage (FT)	Creek Flow (CFS)	Lake Flow (CFS)
2	3.58	3.31	4.39
5	3.80	4.62	4.81
10	4.09	5.50	5.38
25	4.61	6.63	6.43
50	5.11	7.48	7.49
100	5.69	8.34	8.80

Flow Splitter Stage-Storage-Discharge

No	Elev (ft)	Area (AC)	Vol (Ac-ft)	Discharge (Tibbets) (cfs)	Infilt (Lake) (cfs)
1	0.00	0.001154	0.0000	0.0000	0.0000
2	0.10	0.001154	0.0001	0.3573	0.0234
3	0.20	0.001154	0.0002	0.7147	0.0599
4	0.30	0.001154	0.0003	0.9092	0.1066
5	0.40	0.001154	0.0005	1.0573	0.1641
6	0.50	0.001154	0.0006	1.1860	0.2294
7	0.60	0.001154	0.0007	1.2994	0.3015
8	0.70	0.001154	0.0008	1.4069	0.3800
9	0.80	0.001154	0.0009	1.5028	0.4642
10	0.90	0.001154	0.0010	1.5974	0.5539
11	1.00	0.001154	0.0012	1.6820	0.6488
12	1.10	0.001154	0.0013	1.7666	0.7485
13	1.20	0.001154	0.0014	1.8436	0.8528
14	1.30	0.001154	0.0015	1.9197	0.9616
15	1.40	0.001154	0.0016	1.9918	1.0747
16	1.50	0.001154	0.0017	2.0620	1.1919
17	1.60	0.001154	0.0018	2.1300	1.3130
18	1.70	0.001154	0.0020	2.1952	1.4380
19	1.80	0.001154	0.0021	2.2597	1.5668
20	1.90	0.001154	0.0022	2.3213	1.6991
21	2.00	0.001154	0.0023	2.3830	1.8350
22	2.10	0.001154	0.0024	2.4406	1.9744
23	2.20	0.001154	0.0025	2.4982	2.1171
24	2.30	0.001154	0.0027	2.5541	2.2630
25	2.40	0.001154	0.0028	2.6094	2.4122
26	2.50	0.001154	0.0029	2.6633	2.5645
27	2.60	0.001154	0.0030	2.7159	2.7199
28	2.70	0.001154	0.0031	2.7679	2.8784
29	2.80	0.001154	0.0032	2.8188	3.0397
30	2.90	0.001154	0.0033	2.8694	3.2040
31	3.00	0.001154	0.0035	2.9180	3.3712
32	3.10	0.001154	0.0036	2.9666	3.5411
33	3.20	0.001154	0.0037	3.0136	3.7139
34	3.30	0.001154	0.0038	3.0604	3.8893
35	3.40	0.001154	0.0039	3.1063	4.0674
36	3.50	0.001154	0.0040	3.1517	4.2482
37	3.60	0.001154	0.0042	3.4486	4.4315
38	3.70	0.001154	0.0043	4.0602	4.6175
39	3.80	0.001154	0.0044	4.6085	4.8059
40	3.90	0.001154	0.0045	4.9353	4.9969
41	4.00	0.001154	0.0046	5.2620	5.1903
42	4.10	0.001154	0.0047	5.5140	5.3861
43	4.20	0.001154	0.0048	5.7661	5.5844
44	4.30	0.001154	0.0050	5.9897	5.7850
45	4.40	0.001154	0.0051	6.2053	5.9880
46	4.50	0.001154	0.0052	6.4083	6.1933
47	4.60	0.001154	0.0053	6.6013	6.4008
48	4.70	0.001154	0.0054	6.7887	6.6107
49	4.80	0.001154	0.0055	6.9652	6.8228
50	4.90	0.001154	0.0057	7.1402	7.0371
51	5.00	0.001154	0.0058	7.3045	7.2536
52	5.10	0.001154	0.0059	7.4688	7.4723
53	5.20	0.001154	0.0060	7.6242	7.6932
54	5.30	0.001154	0.0061	7.7786	7.9161
55	5.40	0.001154	0.0062	7.9275	8.1412
56	5.50	0.001154	0.0063	8.0737	8.3684
57	5.60	0.001154	0.0065	8.2169	8.5977
58	5.70	0.001154	0.0066	8.3565	8.8290
59	5.80	0.001154	0.0067	8.4947	9.0624
60	5.90	0.001154	0.0068	8.6283	9.2978
61	6.00	0.001154	0.0069	8.7620	9.5351
62	6.10	0.001154	0.0070	9.5082	9.7745
63	6.20	0.001154	0.0072	10.2543	10.0158
64	6.30	0.001154	0.0073	11.1588	10.2591
65	6.40	0.001154	0.0074	12.1084	10.5044
66	6.50	0.001154	0.0075	50.0000	10.7515
67	6.60	0.001154	0.0076	50.0000	11.0006
68	6.70	0.001154	0.0077	50.0000	11.2515
69	6.80	0.001154	0.0078	50.0000	11.5044
70	6.90	0.001154	0.0080	50.0000	11.7591
71	7.00	0.001154	0.0081	50.0000	12.0156
72	7.10	0.001154	0.0082	50.0000	12.2740
73	7.20	0.001154	0.0083	50.0000	12.5343
74	7.30	0.001154	0.0084	50.0000	12.7963
75	7.40	0.001154	0.0085	50.0000	13.0601
76	7.50	0.001154	0.0087	50.0000	13.3258
77	7.60	0.001154	0.0088	50.0000	13.5932
78	7.70	0.001154	0.0089	50.0000	13.8623
79	7.80	0.001154	0.0090	50.0000	14.1332
80	7.90	0.001154	0.0091	50.0000	14.4059
81	8.00	0.001154	0.0092	50.0000	14.6803
82	8.10	0.001154	0.0093	50.0000	14.9564
83	8.20	0.001154	0.0095	50.0000	15.2342
84	8.30	0.001154	0.0096	50.0000	15.5138
85	8.40	0.001154	0.0097	50.0000	15.7950
86	8.50	0.001154	0.0098	50.0000	16.0779
87	8.60	0.001154	0.0099	50.0000	16.3624
88	8.70	0.001154	0.0100	50.0000	16.6486
89	8.80	0.001154	0.0102	50.0000	16.9365
90	8.90	0.001154	0.0103	50.0000	17.2260
91	9.00	0.001154	0.0104	50.0000	17.5172
92	9.10	0.001154	0.0105	50.0000	17.8099
93	9.20	0.001154	0.0106	50.0000	18.1043
94	9.30	0.001154	0.0107	50.0000	18.4003
95	9.40	0.001154	0.0108	50.0000	18.6979
96	9.50	0.001154	0.0110	50.0000	18.9970
97	9.60	0.001154	0.0111	50.0000	19.2978
98	9.70	0.001154	0.0112	50.0000	19.6001
99	9.80	0.001154	0.0113	50.0000	19.9039
100	9.90	0.001154	0.0114	50.0000	20.2094



MAXIMUM PUMPED CREEK DISCHARGE

MAXIMUM PUMPED LAKE SAMMAMISH DISCHARGE

WWHM2012

PROJECT REPORT

General Model Information

Project Name:	Pump Station 1-hour
Site Name:	
Site Address:	
City:	
Report Date:	11/13/2018
Gage:	Seatac
Data Start:	1948/10/01 00:00
Data End:	2009/09/30 00:00
Timestep:	Hourly
Precip Scale:	1.33
Version Date:	2015/11/13
Version:	4.2.11

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year

Landuse Basin Data
Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
SAT, Forest, Flat	8.2
Pervious Total	8.2
Impervious Land Use	acre
Impervious Total	0
Basin Total	8.2

Element Flows To:

Surface	Interflow	Groundwater

Basin 2

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
SAT, Forest, Flat	18.1
Pervious Total	18.1
Impervious Land Use	acre
Impervious Total	0
Basin Total	18.1

Element Flows To:

Surface	Interflow	Groundwater

Basin 3

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
SAT, Forest, Flat	7.6
Pervious Total	7.6
Impervious Land Use	acre
Impervious Total	0
Basin Total	7.6

Element Flows To:

Surface	Interflow	Groundwater

Basin 4

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
SAT, Forest, Flat	9
Pervious Total	9
Impervious Land Use	acre
Impervious Total	0
Basin Total	9

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
SAT, Forest, Flat	8.2
Pervious Total	8.2
Impervious Land Use	acre
Impervious Total	0
Basin Total	8.2

Element Flows To:

Surface	Interflow	Groundwater
SSD Table 1	SSD Table 1	

Basin 2

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
SAT, Forest, Flat	18.1
Pervious Total	18.1
Impervious Land Use	acre
Impervious Total	0
Basin Total	18.1

Element Flows To:

Surface	Interflow	Groundwater
SSD Table 1	SSD Table 1	

Basin 3

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
SAT, Forest, Flat	7.6
Pervious Total	7.6
Impervious Land Use	acre
Impervious Total	0
Basin Total	7.6

Element Flows To:

Surface	Interflow	Groundwater
SSD Table 1	SSD Table 1	

Basin 4

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
SAT, Forest, Flat	9
Pervious Total	9
Impervious Land Use	acre
Impervious Total	0
Basin Total	9

Element Flows To:

Surface	Interflow	Groundwater
SSD Table 1	SSD Table 1	

Routing Elements
Predeveloped Routing

Mitigated Routing

SSD Table 1

Depth: 9.9 ft.
Element Flows To:
Outlet 1 Outlet 2

DISCHARGE TO TIBBETTS CREEK COPIED FROM DETENTION VAULT DISCHARGE

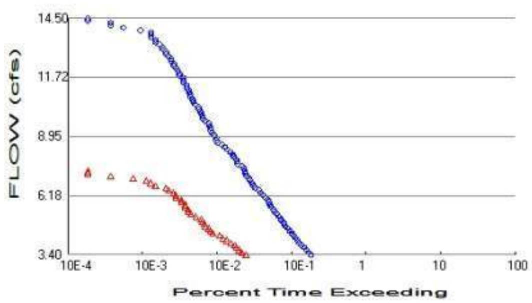
COPIED FROM EXCEL SPREADSHEET DISCHARGE TO LAKE SAMMAMISH

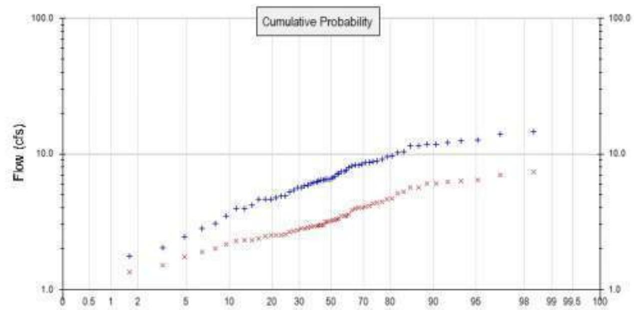
SSD Table Hydraulic Table

Stage (feet)	Area (ac.)	Volume (ac-ft.)	Manual	Infilt (cfs)	NotUsed	NotUsed	NotUsed
0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000
0.100	0.001	0.000	0.357	0.023	0.000	0.000	0.000
0.200	0.001	0.000	0.715	0.060	0.000	0.000	0.000
0.300	0.001	0.000	0.909	0.107	0.000	0.000	0.000
0.400	0.001	0.001	1.057	0.164	0.000	0.000	0.000
0.500	0.001	0.001	1.186	0.229	0.000	0.000	0.000
0.600	0.001	0.001	1.299	0.302	0.000	0.000	0.000
0.700	0.001	0.001	1.407	0.380	0.000	0.000	0.000
0.800	0.001	0.001	1.503	0.464	0.000	0.000	0.000
0.900	0.001	0.001	1.597	0.554	0.000	0.000	0.000
1.000	0.001	0.001	1.682	0.649	0.000	0.000	0.000
1.100	0.001	0.001	1.767	0.749	0.000	0.000	0.000
1.200	0.001	0.001	1.844	0.853	0.000	0.000	0.000
1.300	0.001	0.002	1.920	0.962	0.000	0.000	0.000
1.400	0.001	0.002	1.992	1.075	0.000	0.000	0.000
1.500	0.001	0.002	2.062	1.192	0.000	0.000	0.000
1.600	0.001	0.002	2.130	1.313	0.000	0.000	0.000
1.700	0.001	0.002	2.195	1.438	0.000	0.000	0.000
1.800	0.001	0.002	2.260	1.567	0.000	0.000	0.000
1.900	0.001	0.002	2.321	1.699	0.000	0.000	0.000
2.000	0.001	0.002	2.383	1.835	0.000	0.000	0.000
2.100	0.001	0.002	2.441	1.974	0.000	0.000	0.000
2.200	0.001	0.003	2.498	2.117	0.000	0.000	0.000
2.300	0.001	0.003	2.554	2.263	0.000	0.000	0.000
2.400	0.001	0.003	2.609	2.412	0.000	0.000	0.000
2.500	0.001	0.003	2.663	2.565	0.000	0.000	0.000
2.600	0.001	0.003	2.716	2.720	0.000	0.000	0.000
2.700	0.001	0.003	2.768	2.878	0.000	0.000	0.000
2.800	0.001	0.003	2.819	3.040	0.000	0.000	0.000
2.900	0.001	0.003	2.869	3.204	0.000	0.000	0.000
3.000	0.001	0.004	2.918	3.371	0.000	0.000	0.000
3.100	0.001	0.004	2.967	3.541	0.000	0.000	0.000
3.200	0.001	0.004	3.014	3.714	0.000	0.000	0.000
3.300	0.001	0.004	3.060	3.889	0.000	0.000	0.000
3.400	0.001	0.004	3.106	4.067	0.000	0.000	0.000
3.500	0.001	0.004	3.152	4.248	0.000	0.000	0.000
3.600	0.001	0.004	3.449	4.432	0.000	0.000	0.000
3.700	0.001	0.004	4.060	4.618	0.000	0.000	0.000
3.800	0.001	0.004	4.609	4.806	0.000	0.000	0.000
3.900	0.001	0.005	4.935	4.997	0.000	0.000	0.000
4.000	0.001	0.005	5.262	5.190	0.000	0.000	0.000
4.100	0.001	0.005	5.514	5.386	0.000	0.000	0.000
4.200	0.001	0.005	5.766	5.584	0.000	0.000	0.000
4.300	0.001	0.005	5.990	5.785	0.000	0.000	0.000
4.400	0.001	0.005	6.205	5.988	0.000	0.000	0.000

4.500	0.001	0.005	6.408	6.193	0.000	0.000	0.000
4.600	0.001	0.005	6.601	6.401	0.000	0.000	0.000
4.700	0.001	0.005	6.789	6.611	0.000	0.000	0.000
4.800	0.001	0.006	6.965	6.823	0.000	0.000	0.000
4.900	0.001	0.006	7.140	7.037	0.000	0.000	0.000
5.000	0.001	0.006	7.305	7.254	0.000	0.000	0.000
5.100	0.001	0.006	7.469	7.472	0.000	0.000	0.000
5.200	0.001	0.006	7.624	7.693	0.000	0.000	0.000
5.300	0.001	0.006	7.779	7.916	0.000	0.000	0.000
5.400	0.001	0.006	7.928	8.141	0.000	0.000	0.000
5.500	0.001	0.006	8.074	8.368	0.000	0.000	0.000
5.600	0.001	0.007	8.217	8.598	0.000	0.000	0.000
5.700	0.001	0.007	8.357	8.829	0.000	0.000	0.000
5.800	0.001	0.007	8.495	9.062	0.000	0.000	0.000
5.900	0.001	0.007	8.628	9.298	0.000	0.000	0.000
6.000	0.001	0.007	8.762	9.535	0.000	0.000	0.000
6.100	0.001	0.007	9.508	9.775	0.000	0.000	0.000
6.200	0.001	0.007	10.25	10.02	0.000	0.000	0.000
6.300	0.001	0.007	11.16	10.26	0.000	0.000	0.000
6.400	0.001	0.007	12.11	10.50	0.000	0.000	0.000
6.500	0.001	0.008	50.00	10.75	0.000	0.000	0.000
6.600	0.001	0.008	50.00	11.00	0.000	0.000	0.000
6.700	0.001	0.008	50.00	11.25	0.000	0.000	0.000
6.800	0.001	0.008	50.00	11.50	0.000	0.000	0.000
6.900	0.001	0.008	50.00	11.76	0.000	0.000	0.000
7.000	0.001	0.008	50.00	12.02	0.000	0.000	0.000
7.100	0.001	0.008	50.00	12.27	0.000	0.000	0.000
7.200	0.001	0.008	50.00	12.53	0.000	0.000	0.000
7.300	0.001	0.008	50.00	12.80	0.000	0.000	0.000
7.400	0.001	0.009	50.00	13.06	0.000	0.000	0.000
7.500	0.001	0.009	50.00	13.33	0.000	0.000	0.000
7.600	0.001	0.009	50.00	13.59	0.000	0.000	0.000
7.700	0.001	0.009	50.00	13.86	0.000	0.000	0.000
7.800	0.001	0.009	50.00	14.13	0.000	0.000	0.000
7.900	0.001	0.009	50.00	14.41	0.000	0.000	0.000
8.000	0.001	0.009	50.00	14.68	0.000	0.000	0.000
8.100	0.001	0.009	50.00	14.96	0.000	0.000	0.000
8.200	0.001	0.010	50.00	15.23	0.000	0.000	0.000
8.300	0.001	0.010	50.00	15.51	0.000	0.000	0.000
8.400	0.001	0.010	50.00	15.80	0.000	0.000	0.000
8.500	0.001	0.010	50.00	16.08	0.000	0.000	0.000
8.600	0.001	0.010	50.00	16.36	0.000	0.000	0.000
8.700	0.001	0.010	50.00	16.65	0.000	0.000	0.000
8.800	0.001	0.010	50.00	16.94	0.000	0.000	0.000
8.900	0.001	0.010	50.00	17.23	0.000	0.000	0.000
9.000	0.001	0.010	50.00	17.52	0.000	0.000	0.000
9.100	0.001	0.011	50.00	17.81	0.000	0.000	0.000
9.200	0.001	0.011	50.00	18.10	0.000	0.000	0.000
9.300	0.001	0.011	50.00	18.40	0.000	0.000	0.000
9.400	0.001	0.011	50.00	18.70	0.000	0.000	0.000
9.500	0.001	0.011	50.00	19.00	0.000	0.000	0.000
9.600	0.001	0.011	50.00	19.30	0.000	0.000	0.000
9.700	0.001	0.011	50.00	19.60	0.000	0.000	0.000
9.800	0.001	0.011	50.00	19.90	0.000	0.000	0.000
9.900	0.001	0.011	50.00	20.21	0.000	0.000	0.000

Analysis Results
POC 1





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 42.9
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 42.9
Total Impervious Area: 0

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	6.806202
5 year	9.777016
10 year	11.46781
25 year	13.311147
50 year	14.497567
100 year	15.546507

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	3.307266
5 year	4.621602
10 year	5.504979
25 year	6.633803
50 year	7.483284
100 year	8.339929

Annual Peaks
Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1949	7.557	3.489
1950	11.377	6.060
1951	10.394	5.220
1952	5.616	2.726
1953	5.262	2.648
1954	7.129	3.337
1955	10.184	5.085
1956	8.215	4.101
1957	8.808	4.428
1958	6.332	3.184

1959	4.644	2.504
1960	8.390	3.861
1961	6.448	2.952
1962	3.079	1.989
1963	4.594	2.320
1964	7.920	3.486
1965	6.258	3.136
1966	6.428	3.283
1967	9.708	4.683
1968	5.880	2.823
1969	6.507	3.159
1970	7.419	3.588
1971	5.410	2.700
1972	11.793	5.606
1973	6.650	2.994
1974	4.649	2.508
1975	8.138	4.300
1976	6.371	2.969
1977	2.018	1.505
1978	5.783	2.797
1979	3.931	2.279
1980	4.190	2.369
1981	7.028	3.498
1982	12.152	6.073
1983	4.765	2.539
1984	5.644	2.963
1985	3.955	2.294
1986	8.622	4.016
1987	6.450	2.950
1988	2.820	1.883
1989	2.428	1.725
1990	14.013	6.940
1991	12.693	6.375
1992	6.142	2.882
1993	3.496	2.145
1994	1.757	1.300
1995	6.078	2.862
1996	11.778	5.640
1997	8.242	3.924
1998	4.886	2.525
1999	8.585	3.981
2000	9.181	4.381
2001	1.685	1.344
2002	8.680	4.056
2003	4.906	2.488
2004	12.429	6.323
2005	7.402	3.250
2006	6.795	3.259
2007	11.383	6.231
2008	14.650	7.334
2009	9.569	4.598

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	14.6501	7.3341
2	14.0130	6.9404
3	12.6932	6.3746

4	12.4290	6.3228
5	12.1519	6.2306
6	11.7925	6.0733
7	11.7778	6.0599
8	11.3834	5.6400
9	11.3771	5.6056
10	10.3943	5.2200
11	10.1842	5.0846
12	9.7082	4.6832
13	9.5694	4.5978
14	9.1807	4.4282
15	8.8085	4.3810
16	8.6801	4.3000
17	8.6223	4.1008
18	8.5849	4.0564
19	8.3899	4.0155
20	8.2421	3.9806
21	8.2149	3.9242
22	8.1383	3.8614
23	7.9198	3.5884
24	7.5572	3.4976
25	7.4192	3.4894
26	7.4023	3.4864
27	7.1289	3.3372
28	7.0283	3.2830
29	6.7953	3.2590
30	6.6503	3.2499
31	6.5071	3.1843
32	6.4497	3.1587
33	6.4483	3.1363
34	6.4281	2.9937
35	6.3709	2.9685
36	6.3321	2.9634
37	6.2578	2.9519
38	6.1420	2.9504
39	6.0780	2.8822
40	5.8798	2.8619
41	5.7833	2.8227
42	5.6444	2.7967
43	5.6160	2.7262
44	5.4103	2.7002
45	5.2625	2.6484
46	4.9063	2.5392
47	4.8859	2.5248
48	4.7649	2.5077
49	4.6489	2.5044
50	4.6439	2.4876
51	4.5944	2.3688
52	4.1897	2.3197
53	3.9549	2.2936
54	3.9311	2.2786
55	3.4958	2.1450
56	3.0790	1.9890
57	2.8198	1.8825
58	2.4278	1.7248
59	2.0178	1.5049
60	1.7567	1.3439
61	1.6854	1.3002

Duration Flows

The Facility PASSED ✓

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
3.4031	978	131	13	Pass
3.5152	909	115	12	Pass
3.6272	850	105	12	Pass
3.7393	790	97	12	Pass
3.8514	731	93	12	Pass
3.9634	679	82	12	Pass
4.0755	643	72	11	Pass
4.1876	611	64	10	Pass
4.2996	570	58	10	Pass
4.4117	544	47	8	Pass
4.5238	503	44	8	Pass
4.6358	474	42	8	Pass
4.7479	448	38	8	Pass
4.8600	423	36	8	Pass
4.9720	404	34	8	Pass
5.0841	381	33	8	Pass
5.1961	362	28	7	Pass
5.3082	343	24	6	Pass
5.4203	320	22	6	Pass
5.5323	303	22	7	Pass
5.6444	284	20	7	Pass
5.7565	277	20	7	Pass
5.8685	269	18	6	Pass
5.9806	255	18	7	Pass
6.0927	238	15	6	Pass
6.2047	220	15	6	Pass
6.3168	205	14	6	Pass
6.4289	195	12	6	Pass
6.5409	174	11	6	Pass
6.6530	165	8	4	Pass
6.7651	157	7	4	Pass
6.8771	148	6	4	Pass
6.9892	143	4	2	Pass
7.1013	135	2	1	Pass
7.2133	129	1	0	Pass
7.3254	127	1	0	Pass
7.4375	122	0	0	Pass
7.5495	115	0	0	Pass
7.6616	102	0	0	Pass
7.7736	100	0	0	Pass
7.8857	97	0	0	Pass
7.9978	90	0	0	Pass
8.1098	87	0	0	Pass
8.2219	81	0	0	Pass
8.3340	75	0	0	Pass
8.4460	68	0	0	Pass
8.5581	62	0	0	Pass
8.6702	55	0	0	Pass
8.7822	53	0	0	Pass
8.8943	52	0	0	Pass
9.0064	49	0	0	Pass
9.1184	46	0	0	Pass
9.2305	44	0	0	Pass

9.3426	44	0	0	Pass
9.4546	43	0	0	Pass
9.5667	41	0	0	Pass
9.6788	37	0	0	Pass
9.7908	35	0	0	Pass
9.9029	34	0	0	Pass
10.0150	33	0	0	Pass
10.1270	32	0	0	Pass
10.2391	30	0	0	Pass
10.3512	30	0	0	Pass
10.4632	27	0	0	Pass
10.5753	26	0	0	Pass
10.6873	25	0	0	Pass
10.7994	24	0	0	Pass
10.9115	24	0	0	Pass
11.0235	23	0	0	Pass
11.1356	22	0	0	Pass
11.2477	21	0	0	Pass
11.3597	21	0	0	Pass
11.4718	19	0	0	Pass
11.5839	19	0	0	Pass
11.6959	19	0	0	Pass
11.8080	17	0	0	Pass
11.9201	17	0	0	Pass
12.0321	16	0	0	Pass
12.1442	15	0	0	Pass
12.2563	14	0	0	Pass
12.3683	14	0	0	Pass
12.4804	13	0	0	Pass
12.5925	13	0	0	Pass
12.7045	12	0	0	Pass
12.8166	11	0	0	Pass
12.9287	11	0	0	Pass
13.0407	10	0	0	Pass
13.1528	10	0	0	Pass
13.2648	9	0	0	Pass
13.3769	8	0	0	Pass
13.4890	8	0	0	Pass
13.6010	7	0	0	Pass
13.7131	7	0	0	Pass
13.8252	7	0	0	Pass
13.9372	5	0	0	Pass
14.0493	3	0	0	Pass
14.1614	2	0	0	Pass
14.2734	2	0	0	Pass
14.3855	1	0	0	Pass
14.4976	1	0	0	Pass

Water Quality

Water Quality BMP Flow and Volume for POC #1
On-line facility volume: 0 acre-feet
On-line facility target flow: 0 cfs.
Adjusted for 15 min: 0 cfs.
Off-line facility target flow: 0 cfs.
Adjusted for 15 min: 0 cfs.

LID Report

LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
SSD Table 1 POC	☐	2564.24			☐	18.92			
Total Volume Infiltrated		2564.24	0.00	0.00		18.92	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Passed

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

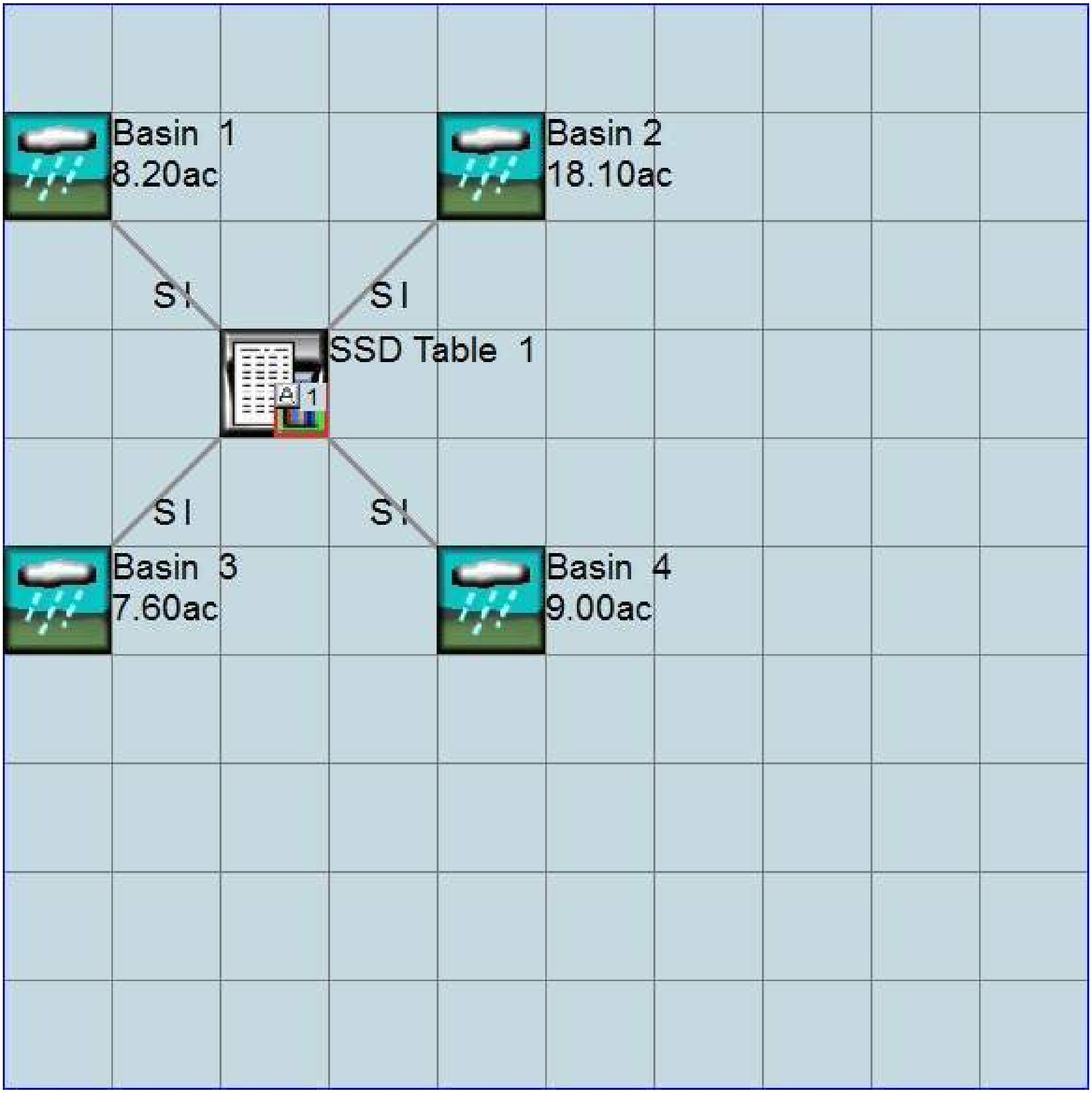
No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic

Mitigated Schematic



Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM        26   Pump Station 1-hour.wdm
MESSU      25   PrePump Station 1-hour.MES
           27   PrePump Station 1-hour.L61
           28   PrePump Station 1-hour.L62
           30   POCPump Station 1-hour1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:60
      PERLND      19
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Basin  1                    MAX                     1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                          in  out           ***
   19      SAT, Forest, Flat       1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   19         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   19         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO
```

```
  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   19         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   19             0         4         2       100     0.001       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   19             0         0        10         2         0         0       0.7
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                                     ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   19           0.2         3       0.5         1       0.7       0.8
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
              ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   19             0         0         0         0       4.2         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name-------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                      in  out           ***
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
  END IWAT-STATE1
```

```
END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  19                         8.2     COPY   501     12
PERLND  19                         8.2     COPY   501     13
Basin 2***
PERLND  19                        18.1     COPY   501     12
PERLND  19                        18.1     COPY   501     13
Basin  3***
PERLND  19                         7.6     COPY   501     12
PERLND  19                         7.6     COPY   501     13
Basin  4***
PERLND  19                           9     COPY   501     12
PERLND  19                           9     COPY   501     13

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   12.1        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                         in  out                             ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ****************** PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                      ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *     *  *  *  *  *       *  *  *  *  *        ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                         ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit       for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
```

```
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1.333     SUM  PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.333     SUM  IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY   501 OUTPUT MEAN   1 1     12.1      WDM    501 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM        26   Pump Station 1-hour.wdm
MESSU      25   MitPump Station 1-hour.MES
           27   MitPump Station 1-hour.L61
           28   MitPump Station 1-hour.L62
           30   POCPump Station 1-hour1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:60
      PERLND      19
      RCHRES       1
      COPY         1
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        SSD Table  1                MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                            User  t-series Engl Metr ***
                                            in  out           ***
   19     SAT, Forest, Flat       1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   19         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   19         0    0    4    0    0    0    0    0    0    0    0    0    1    9
```

```
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   19         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   19              0         4         2       100     0.001       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   19              0         0        10         2         0         0       0.7
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                               ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   19            0.2         3       0.5         1       0.7       0.8
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
              ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   19              0         0         0         0       4.2         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                      in  out           ***
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
```

```
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  19                         8.2     RCHRES   1      2
PERLND  19                         8.2     RCHRES   1      3
Basin 2***
PERLND  19                        18.1     RCHRES   1      2
PERLND  19                        18.1     RCHRES   1      3
Basin  3***
PERLND  19                         7.6     RCHRES   1      2
PERLND  19                         7.6     RCHRES   1      3
Basin  4***
PERLND  19                           9     RCHRES   1      2
PERLND  19                           9     RCHRES   1      3

******Routing******
PERLND  19                         8.2     COPY     1     12
PERLND  19                         8.2     COPY     1     13
PERLND  19                        18.1     COPY     1     12
PERLND  19                        18.1     COPY     1     13
PERLND  19                         7.6     COPY     1     12
PERLND  19                         7.6     COPY     1     13
PERLND  19                           9     COPY     1     12
PERLND  19                           9     COPY     1     13
RCHRES   1                           1     COPY   501     17
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   12.1        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                           in  out                           ***
    1     SSD Table  1           2    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
    1         1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ****************** PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
    1         4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                      ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *          ***
    1        0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
```

```
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
    1            1      0.01       0.0       0.0       0.5       0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                         ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit       for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1          0          4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
  FTABLE      1
  100    5
     Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)      (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.001154  0.000000  0.000000  0.000000
  0.100000  0.001154  0.000100  0.357300  0.023400
  0.200000  0.001154  0.000200  0.714700  0.059900
  0.300000  0.001154  0.000300  0.909200  0.106600
  0.400000  0.001154  0.000500  1.057300  0.164100
  0.500000  0.001154  0.000600  1.186000  0.229400
  0.600000  0.001154  0.000700  1.299400  0.301500
  0.700000  0.001154  0.000800  1.406900  0.380000
  0.800000  0.001154  0.000900  1.502800  0.464200
  0.900000  0.001154  0.001000  1.597400  0.553900
  1.000000  0.001154  0.001200  1.682000  0.648800
  1.100000  0.001154  0.001300  1.766600  0.748500
  1.200000  0.001154  0.001400  1.843600  0.852800
  1.300000  0.001154  0.001500  1.919700  0.961600
  1.400000  0.001154  0.001600  1.991800  1.074700
  1.500000  0.001154  0.001700  2.062000  1.191900
  1.600000  0.001154  0.001800  2.130000  1.313000
  1.700000  0.001154  0.002000  2.195200  1.438000
  1.800000  0.001154  0.002100  2.259700  1.566800
  1.900000  0.001154  0.002200  2.321300  1.699100
  2.000000  0.001154  0.002300  2.383000  1.835000
  2.100000  0.001154  0.002400  2.440600  1.974400
  2.200000  0.001154  0.002500  2.498200  2.117100
  2.300000  0.001154  0.002700  2.554100  2.263000
  2.400000  0.001154  0.002800  2.609400  2.412200
  2.500000  0.001154  0.002900  2.663300  2.564500
  2.600000  0.001154  0.003000  2.715900  2.719900
  2.700000  0.001154  0.003100  2.767900  2.878400
  2.800000  0.001154  0.003200  2.818800  3.039700
  2.900000  0.001154  0.003300  2.869400  3.204000
  3.000000  0.001154  0.003500  2.918000  3.371200
  3.100000  0.001154  0.003600  2.966600  3.541100
  3.200000  0.001154  0.003700  3.013600  3.713900
  3.300000  0.001154  0.003800  3.060400  3.889300
  3.400000  0.001154  0.003900  3.106300  4.067400
  3.500000  0.001154  0.004000  3.151700  4.248200
  3.600000  0.001154  0.004200  3.448600  4.431500
  3.700000  0.001154  0.004300  4.060200  4.617500
  3.800000  0.001154  0.004400  4.608500  4.805900
  3.900000  0.001154  0.004500  4.935300  4.996900
  4.000000  0.001154  0.004600  5.262000  5.190300
  4.100000  0.001154  0.004700  5.514000  5.386100
  4.200000  0.001154  0.004800  5.766100  5.584400
  4.300000  0.001154  0.005000  5.989700  5.785000
  4.400000  0.001154  0.005100  6.205300  5.988000
  4.500000  0.001154  0.005200  6.408300  6.193300
  4.600000  0.001154  0.005300  6.601300  6.400800
```

```
  4.700000  0.001154  0.005400  6.788700  6.610700
  4.800000  0.001154  0.005500  6.965200  6.822800
  4.900000  0.001154  0.005700  7.140200  7.037100
  5.000000  0.001154  0.005800  7.304500  7.253600
  5.100000  0.001154  0.005900  7.468800  7.472300
  5.200000  0.001154  0.006000  7.624200  7.693200
  5.300000  0.001154  0.006100  7.778600  7.916100
  5.400000  0.001154  0.006200  7.927500  8.141200
  5.500000  0.001154  0.006300  8.073700  8.368400
  5.600000  0.001154  0.006500  8.216900  8.597700
  5.700000  0.001154  0.006600  8.356500  8.829000
  5.800000  0.001154  0.006700  8.494700  9.062400
  5.900000  0.001154  0.006800  8.628300  9.297800
  6.000000  0.001154  0.006900  8.762000  9.535100
  6.100000  0.001154  0.007000  9.508200  9.774500
  6.200000  0.001154  0.007200  10.25430  10.01580
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  9.400000  0.001154  0.010800  50.00000  18.69790
  9.500000  0.001154  0.011000  50.00000  18.99700
  9.600000  0.001154  0.011100  50.00000  19.29780
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  9.800000  0.001154  0.011300  50.00000  19.90390
  9.900000  0.001154  0.011400  50.00000  20.20940
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END FTABLES

EXT SOURCES
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<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1.333     SUM  PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.333     SUM  IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
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RCHRES   1 HYDR   RO     1 1        1      WDM   1000 FLOW     ENGL      REPL
```

```
RCHRES   1 HYDR   O       1 1        1       WDM   1001 FLOW     ENGL      REPL
RCHRES   1 HYDR   O       2 1        1       WDM   1002 FLOW     ENGL      REPL
RCHRES   1 HYDR   STAGE   1 1        1       WDM   1003 STAG     ENGL      REPL
COPY     1 OUTPUT MEAN    1 1     12.1       WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN    1 1     12.1       WDM    801 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK        2
PERLND     PWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    2

  MASS-LINK        3
PERLND     PWATER IFWO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    3

  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13

  MASS-LINK       17
RCHRES     OFLOW  OVOL   1                 COPY           INPUT  MEAN
  END MASS-LINK   17

END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

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Local (360)943-0304

www.clearcreeksolutions.com

Worksheet for Manhole Opening

Project Description

Solve For	Headwater Elevation

Input Data

Discharge		10.50	ft³/s
Crest Elevation		0.00	ft
Tailwater Elevation		0.00	ft
Weir Coefficient		3.33	US
Crest Length		5.60	ft
Number Of Contractions	2		

Results

Headwater Elevation	0.69	ft
Headwater Height Above Crest	0.69	ft
Tailwater Height Above Crest	0.00	ft
Flow Area	3.88	ft²
Velocity	2.70	ft/s
Wetted Perimeter	6.99	ft
Top Width	5.60	ft

8.28 inches is less than window height of 12 inches. Flow will be non-pressurized

Dispersion Trench Weir Length	Made by: CB	Date: 10/4/2018	Project: HCPSD
			1 of 2

Location Desc.: Force Main Discharge Dispersion Trench Weir Length

Input = XXX
Calculation = **XXX**

Given:

Design Storm	N/A	yr	
Q =	10.50	cfs	
W =	80.00	ft	(Level Spreader Width)
S_o =	0.0500	ft/ft	Assume 5% downstream slope
n =	0.115		Manning's Coefficients (from Appendix A4-1-1)

Calculation:

From Hydraulics Manual Fig. 4-2.2.1:

$V = (1.486/n) \times R^{2/3} \times S_o^{1/2}$

where

$R \approx D$ (For shallow flow, Hydraulic Radius ≈ Depth)

$A = W \times D$ (Flow area immediately downstream of pad)

$Q = V \times A$

D = **0.16** ft

Shear Stress:

Shear stress = WHG = (Weight of Water)x(height of Water)x(Channel Gradient)

Shear stress **0.48812** lb/ft^2

Dispersion Trench Weir Length	Made by: CB	Date: 10/4/2018	Project: HCPSD
			2 of 2

Location Desc.: ***Force Main Discharge Dispersion Trench Weir Length***
(CONT.)

From Table 6A-3. Maximum Permissible Shear Stresses for Flexible Liners

Liner Category	Liner Type	Permissible Shear Stress Low	High	Result Check Low End	Check High End
Non-Cohesive Bare soil		0.01	0.04	Erode	Erode
Cohesive bare soil					
	Noncompacted		0.10		Erode
	Compacted		0.80		O.K.
Erosion Control blankets					
	Jute	0.45	1.00	Erode	O.K.
	Curlex wood or straw	1.00	2.50	O.K.	O.K.
	Coir	2.00	4.00	O.K.	O.K.
	Organic, synthetic, or mix	10.00	12.00	O.K.	O.K.
Vegetative (varies w/ type and density of grass stand)					
	Uncut stand	2.10	3.70	O.K.	O.K.
	Cut grass	0.60	1.00	O.K.	O.K.
Gravel/Riprap					
	1-inch		0.33		Erode
	2-inch		0.67		O.K.
	6-inch		2.00		O.K.
	12-inch		4.00		O.K.

Results/Notes:

CUT GRASS DOWNSTREAM OF 80' LEVEL SPREADER IS OK.

Worksheet for Dispersion Trench

Project Description

Solve For	Headwater Elevation

Input Data

Discharge	10.50	ft³/s
Crest Elevation	0.00	ft
Tailwater Elevation	0.00	ft
Weir Coefficient	3.33	US
Crest Length	80.00	ft
Number Of Contractions	2	

Results

Headwater Elevation	0.12	ft
Headwater Height Above Crest	0.12	ft
Tailwater Height Above Crest	0.00	ft
Flow Area	9.27	ft²
Velocity	1.13	ft/s
Wetted Perimeter	80.23	ft
Top Width	80.00	ft

1.44 inches

Appendix C

Critical Areas Existing Conditions Summary Memo, Talasaea Consultants

TALASAEA
CONSULTANTS, INC.

16 November 2018

TAL-1775

kpff
1601 Fifth Avenue, Suite 1600
Seattle, WA 98101

REFERENCE: **Hyla Crossing Stormwater Force Main Outfall,**
Issaquah, Washington
SUBJECT: Critical Areas Existing Conditions Summary Memo

To whom it may concern:

This memo is intended to summarize the existing conditions within the project area of the proposed Hyla Crossing Stormwater Force Main Outfall between Hyla Crossing and Lake Sammamish. The project proposes to construct a new stormwater outfall into Lake Sammamish as required by the Hyla Crossing Developer Agreement. A preliminary design for the outfall was previously evaluated and conceptually approved by the City in 2011. A SEPA MDNS was issued that outlined the anticipated impacts to Lake Sammamish for the new outfall. However, after further assessment, and considering the poor condition of the wetland, Wetland E (see Field Investigations below) near where the previous outfall was proposed, the design for the outfall was re-evaluated and a dispersion trench is proposed to be installed in the outer limits of the Wetland E that would have lower environmental impacts than the original outfall into the lake. A brief assessment of these two alternative methods for discharging the stormwater into the lake is also provided below.

PROJECT DESCRIPTION

The project area will cross portions of several parcels, including properties owned by the City of Issaquah (City of Issaquah's Greenwood Property and local rights-of-way), Washington State Parks (Lake Sammamish State Park), Rowley Properties, Inc., and the Washington Department of Transportation (WSDOT) for a crossing under Interstate 90 (I-90). A pump station will be constructed near the intersection of NW Poplar Way and 19th Avenue NW. The proposed pipeline route will extend from the pump station westward along NW Poplar Way before crossing under I-90 into Wetland E. The pipeline will need to convey the stormwater to Lake Sammamish, either through a direct discharge pipe as was previously conceptually approved (a bottom nearshore outfall near an existing pier) or through a dispersion trench located in the outer limits of Wetland E.

Sammamish Cove Park is flanked by Tibbett's Creek to the east and Schneider Creek to the west, with Lake Sammamish to the north and NW Sammamish Road to the south. Sammamish Cove Park occurs adjacent to Lake Sammamish State Park, which includes the land on which existing ball fields occur between Sammamish Cove Park and where Tibbett's Creek first exits from underneath I-90.

BACKGROUND INFORMATION

Background information from the following sources was reviewed prior to field investigations:

- US Fish and Wildlife Service (USFWS) Wetlands Online Mapper (National Wetlands Inventory, NWI);
- Natural Resources Conservation Service (NRCS), Web Soil Survey;
- King County GIS (King County, 2018);
- City of Issaquah Critical Areas Map (City of Issaquah, 2018);
- City of Issaquah GIS (City of Issaquah, 2018);
- Washington Department of Fish and Wildlife (WDFW) Priority Habitats and Species (PHS) Database on the Web;
- Fish usage data from SalmonScape and StreamNet;
- Orthophotography from Earth Explorer (2018), Google Earth (2018); and Historic Aerials (2018).

FIELD INVESTIGATIONS

This project area was evaluated for critical areas on 8 and 11 October 2018 to identify baseline existing conditions. Critical areas identified within or adjacent to the project area include Lake Sammamish, Tibbett's Creek, Schneider Creek, and six (6) wetlands that occur in association with the above waterbodies (**Figure 1**). Both Tibbett's Creek and Schneider Creek begin south of I-90. Another wetland occurs in a ditch south of I-90 parallel to the highway. See Table 1 below for a summary of critical areas within the project area.

Feature ID	Rating (Habitat Score) or Typing	Standard Buffer (feet)
Wetland A	III (5)	75
Wetland B	III (5)	75
Wetland C	III (5)	75
Wetland D	III (5)	75
Wetland E	III (6)	75
Wetland F	II (6)	100
Off-Site Wetland	III (4)	50
Tibbett's Creek	Class 2 with Salmonids	100
Schneider Creek	Class 2 with Salmonids	100
Lake Sammamish[1]	Class 1 (Shoreline of the State)	35[2]

[1]The OHWM for Lake Sammamish is defined by a field delineation, elevation 31.76 feet (NAVD88) or elevation 28.18 feet (NGVD29).
[2]The 35-foot standard setback to Lake Sammamish does not apply to water-dependent utilities such as stormwater discharges or outfalls. As a Shoreline of the State, shorelands extend from the OHWM of Lake Sammamish equaling 200 feet plus the extent of Wetland E.

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The routine approach described in the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region* (U.S. Army Corps of Engineers, 2010) was used as a baseline for evaluating the Site for the presence of wetlands. Ordinary high water mark (OHWM) was determined using the Washington State Department of Ecology's (DOE) publication, *Determining the Ordinary High Water Mark for Shoreline Management Act Compliance in Washington State* (2016). Wetlands were rated using the 2014 *Washington State Wetland Rating System for Western Washington*, as published by DOE.

WETLANDS

Wetlands A, B, C, and D

Wetlands A, B, C, and D are small depressional areas that occur within Lake Sammamish State Park around the existing ballfields (**Figures 1 & 2**). These wetlands are low areas that are dominated by reed canarygrass (*Phalaris arundinacea*) that pond water. Soils within these wetlands exhibited hydric soil indicators. A trail separates these wetlands from Tibbett's Creek. Some of these small wetlands are connected via small pvc drain pipes. These wetlands rated as Category III wetlands with Habitat Scores of 5.

Wetland E

Wetland E is an approximately 17-acre wetland that is dominated by reed canarygrass over the vast majority. Wetland E has an approximately 0.7% gradient from the upper edges of the wetland to the lakeshore. Areas of other native vegetation occur near the perimeters of this wetland with a forested stretch located along the lake shoreline and at the eastern edge of this wetland adjacent to Tibbett's Creek. Typical native species within the wetland include several species of willow (*Salix sp.*), red alder (*Alnus rubra*), black cottonwood (*Populus trichocarpa*), and other common wetland shrubs though their total cover is low. A somewhat natural levee occurs adjacent to Tibbett's Creek that was included within the delineation. This levee was constructed some time before 1969, the most recent year of aerial imagery available through Historicaerials.com, likely in conjunction with the ditching of Tibbetts Creek.

This wetland is flanked by NW Sammamish Road to the south and ties into a roadside swale associated with this road. Tibbett's Creek is located to the north, Schneider Creek to the west, and Lake Sammamish to the northwest. The eastern boundary of this wetland occurs at the edge of the maintained ballfields. Based on a soils analysis, the ballfields appear to have been filled in and leveled at some point in the past to create that the fields. While Schneider Creek and Tibbett's Creek occur on either side of this wetland, hydrologically this wetland drains to Lake Sammamish. Both streams likely have the potential to overflow into Wetland E during extreme high water events, but Wetland E has little opportunity to contribute hydrology back to either stream. Wetland E rated as a Category III wetland with a Habitat Score of 6.

Wetland F

Wetland F is a riparian wetland that occurs adjacent to the left bank of Tibbett's Creek within the greater stream corridor. A pedestrian trail is located immediately uphill of the wetland, on the upper side of the clear topographical break in the landscape. This wetland is dominated by woody trees and shrubs at the upper limits and wet-adapted herbaceous species nearer to the channel. Dominant species included several species of willow and sedges (*Carex sp.*), and reed canarygrass. Wetland F rated as a Category II wetland with a Habitat Score of 6.

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STREAMS AND LAKE SAMMAMISH

In addition to the wetlands, Tibbett's Creek, Schneider Creek, and Lake Sammamish are all fish-bearing waters that occur in proximity to the wetlands. Multiple species of salmonids are known to occur in all three waterbodies. All of the wetlands and streams ultimately drain to Lake Sammamish, a Shoreline of the State. The shorelands extend 200 feet landward from the OHWM of the lake and include the entirety of Wetland E. The FEMA-mapped 100-year floodplain occurs more or less over the same area identified as Wetland E. Tibbett's and Schneider Creeks convey natural water from the hills to the south, as well as picking up stormwater from surrounding developments. Both streams have current indicators of beaver activity and multiple dams are present in both stream channels. Flows in Schneider Creek have been diverted into Wetland E just north of the I-90 culvert due to a large beaver dam (**Figures 1 & 2**).

ANALYSIS OF OPTIONS

The initial EIS addressed a new outfall that would discharge into the lake. However, outfalls disrupt the natural lakeshore environmental processes, including sediment transport, and are usually not a preferred option by Agencies if alternatives exist. Allowing the discharge to slowly release into the lake through a dispersion trench near the upper limits of Wetland E would be a more environmentally friendly solution that would enhance the hydrology of the wetland and provide a slow release to the lake. While placing the dispersion trench in the uplands outside of the wetland would be ideal, the landscape in this particular area does not lend itself to an upland placement of the dispersion trench. The community ball fields occur immediately uphill from the wetland. The placement of the dispersion trench inside of the wetland would ensure no future impact on the ballfields or other community enjoyment of this public park.

The drainage basin for Wetland E has been negatively impacted through the extensive development around this area. Much of the area stormwater is routed to the lake through other surface connections other than this wetland. Direct discharges to Wetland E are limited to precipitation and groundwater from the immediate surroundings in the existing condition. The placement of the dispersion trench would facilitate the distribution of added hydrology into this wetland. Infiltrated stormwater would slowly migrate to the lake as interflow. Supplemental plantings of woody trees and shrubs would help reduce the prevalence of reed canarygrass within those areas. A dispersion trench at the upper limits of Wetland E would help to restore hydrology to this impacted wetland, would allow the wetland to serve as additional treatment to the stormwater, and would slow the release of water into the lake.

In addition to the hydrologic benefits to Wetland E resulting from a dispersion trench, construction impacts to critical areas will be much less for a dispersion trench than a direct outfall into Lake Sammamish. A new outfall would require trenching the full length of Wetland E, a cofferdam at the lake shoreline and in-water construction for the outfall structure itself, which would impact the lake fringe wetland along Lake Sammamish. In contrast, the dispersion trench would only impact a very small area at the upper end of Wetland E with the construction of a manhole and dispersion trench. Construction access is much better for the dispersion trench than a new lake outfall. Taken as a whole, the proposed dispersion trench into Wetland E is a much better solution environmentally for stormwater release than a direct outfall into the lake for both the wetland, lake, and the species that utilize both of these critical areas.

Dispersion trench design should be the minimum impact to the wetland necessary to construct a dispersion trench that will meet the needs of the flows and protect the dispersion trench from natural or man-made intrusions to minimize long-term maintenance requirements.

REQUIRED PERMITS

The proposed dispersion trench would require generally the same permits as the previously approved outfall, and would include permits through Federal, State, and local agencies.

SUMMARY

We evaluated the Site in October 2018. Critical areas identified within or adjacent to the project area include Lake Sammamish, Tibbett's Creek, Schneider Creek, and six (6) wetlands that occur in association with the above waterbodies. Both Tibbett's Creek and Schneider Creek begin south of I-90. Another wetland occurs in a ditch south of I-90 parallel to the highway. Lake Sammamish is a Shoreline of the State with shorelands extending through Wetland E.

While the previous approvals described a new outfall into Lake Sammamish directly, redirecting those flows into Wetland E through a dispersion trench is a more environmentally friendly solution. A dispersion trench at the upper limits of Wetland E would help to restore hydrology to this impacted wetland, would allow the wetland to serve as additional treatment to the stormwater, and would slow the release of water into the lake. Taken as a whole, a dispersion trench into Wetland E is a much better solution environmentally for stormwater release with far fewer construction-related impacts than a direct outfall into the lake for both the wetland, lake, and the species that utilize both of these critical areas.

We trust that the information presented here sufficiently answers your comments and that you will be able to move this project forward. If you have additional questions or require more information, please contact Ann Olsen or me at (425) 861-7550.

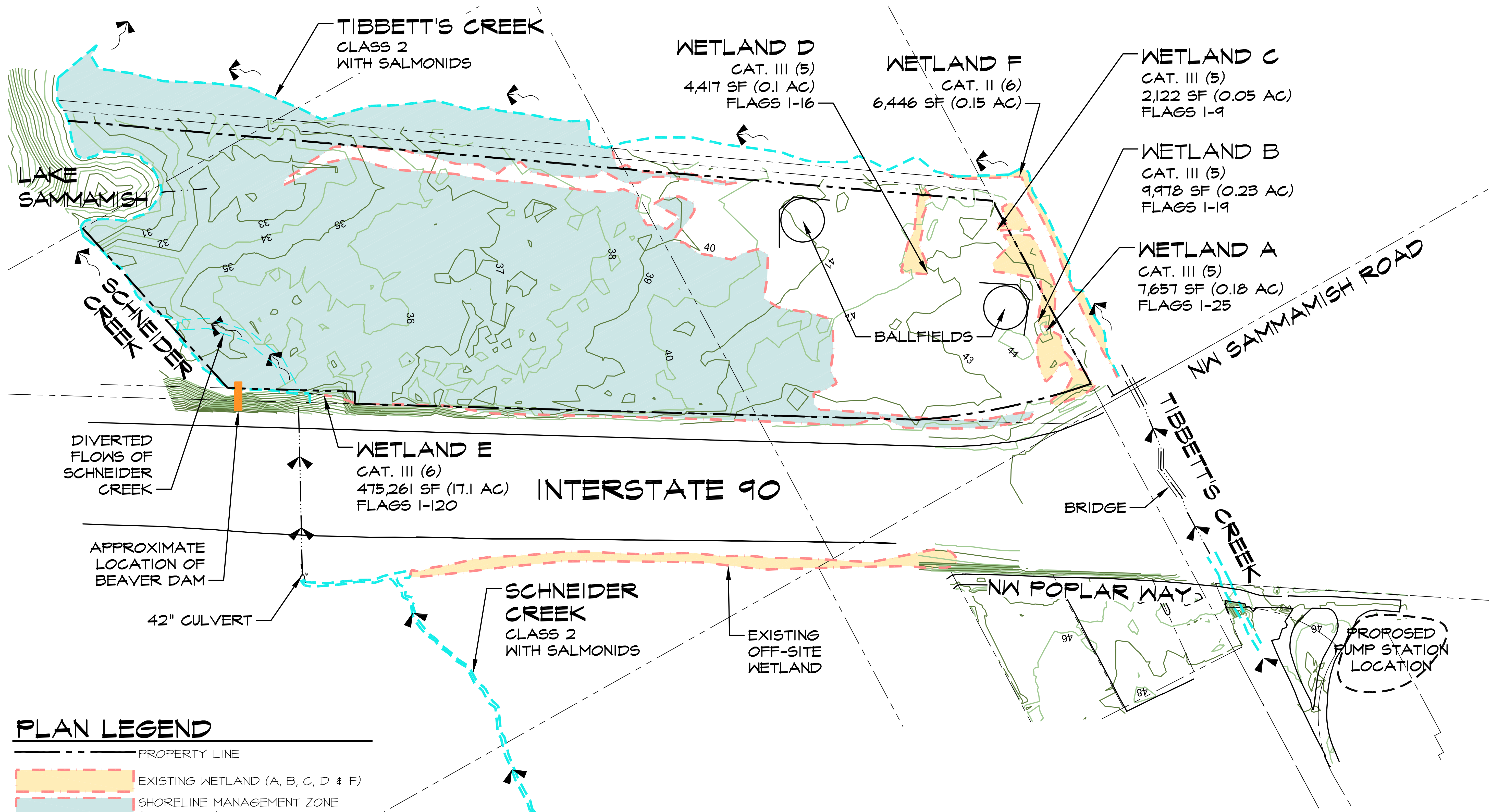
Thank you.
Sincerely,

TALASAEA CONSULTANTS, INC.

Jennifer M. Marriott, PWS
Senior Ecologist/Project Manager

Attachments:

Figure 1. Existing Conditions Map
Figure 2. Critical Area Overview



PLAN LEGEND

- PROPERTY LINE
- EXISTING WETLAND (A, B, C, D & F)
- SHORELINE MANAGEMENT ZONE (WETLAND E)
- ORDINARY HIGH WATER MARK
- DIRECTION OF FLOW
- 101 EXISTING CONTOUR (ODD)
- 100 EXISTING CONTOUR (EVEN)

GRAPHIC SCALE
(IN FEET)
0 100 200 400
SCALE: 1"=200'

NORTH

TALASAEA CONSULTANTS, INC.
Resource & Environmental Planning
15020 Bear Creek Road Northeast
Woodinville, Washington 98077
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FIGURE #1

EXISTING CONDITIONS OVERVIEW

HYLA CROSSING STORMWATER FORCE MAIN
ISSAQUAH, WASHINGTON

DESIGN	DRAWN	PROJECT
JM/AO	ABS	1775

SCALE: AS SHOWN

DATE: 11-14-2018

REVISED

1

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AERIAL SOURCE: GOOGLE EARTH; IMAGE DATE MAY-2018

PLAN LEGEND

- PROPERTY LINE
- EXISTING WETLAND
- ORDINARY HIGH WATER MARK
- DIRECTION OF FLOW
- EXISTING TRAILS

GRAPHIC SCALE
(IN FEET)
0 100 200 400
SCALE: 1"=200'

NORTH

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FIGURE #2

CRITICAL AREA MAP

HYLA CROSSING STORMWATER FORCE MAIN
ISSAQUAH, WASHINGTON

DESIGN	DRAWN	PROJECT
JM/AO	ABS	1775
SCALE		
AS SHOWN		
DATE		
11-14-2018		2
REVISED		

Z:\DRAWING\1700-1799\TAL1775\Plans\TAL-1775 WP 2018-11.dwg

Appendix D

Pump Options, Notkin Mechanical Engineers

notkin
mechanical engineers

www.notkin.com
phone 206-448-1911 fax 206-448-9485
2301 Fifth Avenue, Suite 401
Seattle, Washington 98121

November 14, 2018

Project: Hyla Crossing Direct Lake Discharge
(Notkin Project No. 218078)

Subject: Pump Options

This letter is to discuss the options for pumps under consideration for the Hyla Crossing Direct Lake Discharge project. This letter considers the type of pump used, and the use of variable frequency drives (VFD).

This project is using pumps to direct water flow to either the nearby creek or to Lake Sammamish, in place of using a detention pond. The project is in the conceptual design phase for pump design. The building required to house the pumps will be somewhat defined by the type of pump selected. The goal of this design will be to provide a system that is easy to operate and maintain.

This design considered two types of pumps: submersible pumps and vertical turbine pumps.

Submersible pumps: The submersible pumps have a cleaner installation because the pumps are in the tank below the floor, which leaves open floor space above. The open space provides better access to the piping and valves for maintenance, and reduces the required size for the pump building. The smaller building will have lower first cost and lower maintenance cost.

The pumps are also easy to remove for maintenance and repairs. The submersible pumps that are the basis of design can be removed with a permanently installed winch. That will allow all maintenance of the pumps without requiring work in the tank, or requiring a crane to pull the pump out of the water.

Vertical turbine pumps: The vertical turbine pumps are installed with the motor in the pump room, and the impeller in the tank below. This installation allows easy maintenance of the motor, but requires a crane to remove the entire assembly if the pump impeller or shaft needs maintenance or repairs.

<u>Recommendation</u>**:** The submersible pump design is recommended because the entire pump assembly can be lifted out of the water with the permanently installed winch. A crane rental won't be required for maintenance.

Variable Frequency Drives: A variable frequency drive (VFD) would allow the pumps to turn down to 20% of maximum flow; without a VFD, the pumps will only run at maximum flow. Reducing the flow will allow the pumps to run longer, while using a smaller tank. One of the requirements of large pumps is that they can only start a limited number of times per hour; often 3-4 times per hour defined by quality

is recommended. This requires the pump to be sized for around 10 minutes of run time. At 10.5 cubic feet per second, the tanks would need to be over 6,000 cubic feet. Our current design has the largest tank at about 1,200 cubic feet. The reduction in pump starting and stopping also increases the life of the pumps and motors.

Recommendation: A variable frequency drive is recommended. This will reduce the size of the tank and increase the life of the pumps.

If you have any questions or require any additional information, please give me a call.

NOTKIN MECHANICAL ENGINEERS

Sean Riley

Sean Riley, P.E., LEED® AP
Principal

SR: st

W:\218078 - Hyla Pump Room\Correspondence\2018-11-14_Pump Options Letter.docx

Appendix E

Previous KPFF Reports for Reference

1601 Fifth Avenue, Suite 1600 Seattle, WA 98101 206.622.5822 kpff.com

Technical Memorandum

Date September 9, 2015

Subject Force Main Preliminary Sizing Study – Rowley Properties, Issaquah, WA

Prepared By Scott Meurn, PE

Prepared for Rowley Properties and the City of Issaquah

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I. EXECUTIVE SUMMARY

In order to support future planned development at the Rowley Center and Hyla Crossing, we have performed preliminary analysis on the required capacity of the storm drainage pump station and force main system that will be constructed in-lieu of providing storm water detention as allowed by the Master Drainage Plan (MDP). An update to the Issaquah Addendum to the King County Surface Water Design Manual (KCSWDM) has occurred since the Master Developer Agreement (MDA) and associated MDP were completed that govern the design of this system.

Since the development and adoption of the MDP, the City of Issaquah has determined that all sites, including Rowley Center, draining to Tributary 0170 may use the existing predeveloped condition when determining flow control requirements. This decision is documented in the 2011 Issaquah Addendum to the 2009 King County Surface Water Design Manual (KCSWDM) section 1.1.5. This effectively removes the detention requirement from the Rowley Center since it is fully developed and any new development would likely have little change in lot coverage.

Furthermore, an adjacent developer is proposing to improve a portion of NW Poplar Way to support their development. The proposed adjacent development is known as the Mull Farm Apartment Development. NW Poplar Way is a private road owned by Rowley Properties which contains existing utilities that serve the Mull Farm Apartment site. New utilities will be installed by that project to support a more densely developed site. In order to reduce impact to NW Poplar Way it is desirable to install the portion of the force main in NW Poplar Way with the Mull Farm development. Installing the force main at this time would also ensure that sufficient space is allocated for the force main related to the other proposed and existing utilities. To be clear, the force main and pump station would not serve the Mull Farm Apartments

The purpose of this technical memorandum is to estimate the design flow rate and size of the force main so that the appropriate size pipe can be installed with the Mull Farm Apartment utilities at the same time as site work is being conducted as well as to begin preliminary design and permitting efforts associated with the pump station and force main. Through the course of revisiting the MDP and calculating the force main size based on eliminating the Rowley Center from the tributary area, it was discovered that the MDP calls for a larger sizing criteria than the code requires and has very conservative assumptions built into the calculations. We recommend that the system be designed as described in the Conclusions and Recommendations section of this memorandum, which are consistent with our technical memorandum dated December 8, 2009 and updated March 19, 2014.

The analysis excludes other components of the drainage system including the pump station, water quality treatment, and flow splitter. The summary of the results of the calculations contained herein are considered preliminary and are for discussion purposes.

II. DRAINAGE CODE REVIEW

The basis of design for the force main is based on the following drainage codes.

Reference 1: December 2011 Rowley Center and Hyla Crossing MDP

Reference 2: 2011 City of Issaquah Addendum to the 2009 KCSWDM

Reference 3: 2009 KCSWDM

The reference codes are listed in order of priority. When conflicts exist, the higher ranked code governs. The MDP, however, is stated to be a working document based on the City and County codes that allows for flexibility which is imperative to any re-development project given complexities associated with navigating the existing build environment. The MDP is associated with the FEIS and the Development Agreement for the Hyla Crossing and Rowley Center Project.

The method outlined in the MDP for determining the capacity of the system is based on peak flow analysis and is consistent with Level 3 Flow Control. The predeveloped 100-year peak flow using King County Runoff Time Series (KCRTS) is calculated using a one hour time step and assuming a 100 percent forested basin. The developed 100-year peak flow using the Santa Barbara Unit Hydrograph (SBUH) method is then calculated using a Type-1A storm, a ten minute time of concentration, and a 100 percent impervious basin to simulate a fully developed basin with a high groundwater table. The difference in the two peak flows is what the MDP requires to be pumped to the lake via force main. This method results in the 76 cubic feet per second (CFS) pump requirement noted in section 4 of the MDP.

The method used in the original KPFF technical memorandum, dated December 8, 2009 and updated March 19, 2014, to estimate the size of the system is consistent with the KCSWDM and Issaquah Addendum for Level 2 Flow Control, which is the level of flow control required by code. This approach does not convey base or flood flows via the force main, its premise is to use the force main as a detention substitute. In that analysis, durations of ½ the 2-year through the 50-year predeveloped peak flows were analyzed and a pump and force main system was selected to discharge flows only in excess of Tibbetts Creek base flow. The existing ditches and conveyance systems tributary to Tibbetts Creek would convey the base flows as well as flood flows not requiring attenuation.

The two methodologies result in a similar design except that the MDP method conveys an equivalent of Level 3 flow control to the lake whereas the proposed method conveys an equivalent of Level 2 flow control to the lake. The standard for flow control per the 2011 City of Issaquah addendum to the 2009 KCSWDM requires Level 2 flow control in accordance with Section 1.2.3.1. Table 1, Criteria Comparison compares the code required criteria with the proposed methodology and MDP methodology.

Table 1 – Criteria Comparison

Code Category	Code Sub-category	2009 KCSWDM & 2011 Issaquah Addendum	1/2 the 2 yr - 50 year Durations (Proposed)	Master Drainage Plan (MDP)
Core Requirement #3: Flow Control	Level 2 Flow Control	1.2.3.2 - **Level 2 Flow Control** - Match developed discharge durations to predeveloped durations for the range of predeveloped discharge rates from 50% of the 2-year peak flow up to the full 50-year peak flow. Also match developed peak discharge rates to predeveloped peak discharge rates for the 2- and 10-year return periods.	**Compliant** – Historical flows (bypass) and flows in excess of 50-year durations are conveyed to the Tibbetts Creek. All other flows are conveyed via the pump station to the Lake. **(Consistent with Level 2 Flow Control)**	**Above and Beyond Compliant** - Historical flows (bypass) and flows in excess of 100-year peak flows are conveyed to the Tibbetts Creek. All other flows are conveyed via the pump station to the Lake. **(Consistent with Level 3 Flow Control)**
Core Requirement #4: Conveyance System	Design Event	1.2.4.1 - Pipes shall convey the developed 25-yr peak flow. The 100 -yr peak flow may overtop structures, provided the overflow does not create or aggravate a severe flooding problem or severe erosion problem.	**Compliant** - Uses existing conveyance system to convey base flow and flood flows exceeding 50-year durations to Tibbetts Creek.	**Above and Beyond Compliant** - Uses force main to convey flood flows up to 100-year peak minus the base flow. Base flows and flows exceeding the 100-year peak are conveyed to Tibbetts Creek.

III. SYSTEM SIZING

The tributary area to the pump station/force main will be reduced in order to remove the Rowley Center from the tributary area. The results of calculations for the size of the force main are summarized in Table 2 – Force main Sizing Matrix. The calculations are based on removing the Rowley Center from the tributary area of the pump station and maintain the conservative assumption of 100% impervious surface coverage. The remainder of areas in Table 3 – Developed Conditions With Lake Discharge from the MDP are considered the tributary area of the pump station in these preliminary calculations.

The size of the force main can be adjusted up or down depending on the size of the pump which is excluded from this analysis. A smaller force main can pass the same flow rate as a larger one if the pumps are selected to overcome a greater total dynamic head. However, there are limits to this. As the velocities increase within the pipe, the friction losses increase exponentially.

Generally, velocities resulting in an efficient system range from 8 to 12 feet per second. The MDP allows for a maximum velocity of 20 feet per second. Table 2 contains a matrix of the two methodologies for calculating the peak flow analyzed when the force main is flowing 8 feet per second, 12 feet per second, and 20 feet per second.

At 20 feet per second, the system becomes infeasible due to extreme pressure required at the pump. We recommend keeping the velocity closer to 12 feet per second as the system as a whole becomes more optimized. Depending on the sizing method, we estimate the size of the force main to be 19-inch to 29-inch inside diameter.

Table 2 – Force Main Sizing Matrix

	8 FPS			12 FPS			20 FPS		
	Pipe I.D. (IN)	Pressure at Pump Station* (PSI)	Friction Head Loss (FT)	Pipe I.D. (IN)	Pressure at Pump Station* (PSI)	Friction Head Loss (FT)	Pipe I.D. (IN)	Pressure at Pump Station* (PSI)	Friction Head Loss (FT)
Match 1/2 2yr - 50yr Durations **21.7 CFS****	23	15.6	31.1	19	40.2	87.8	15	135.0	306.3
100yr SBUH - 100yr KCRTS Predeveloped **52.7 CFS****	35	10.7	19.7	29	25.4	53.5	22	105.2	237.7

* Assuming the elevation of the lake surface is at EL 35' and pump is at EL 30' (buried 20' underground in vault).
** Discharge rates were adjusted to remove TDA 2, Rowley Center, from the tributary area.

The above matrix assumes that the tributary area to the force main and pump station are consistent with Table 3 of the MDP minus TDA 2. This excludes any non-Project properties that might be tributary to this system as Section 5.2.4 of the Developer Agreement indicates there is the potential for.

IV. SYSTEM LAYOUT

This section is a review of minimum code requirements for the force main to be located within NW Poplar Way. The following criteria should be considered when selecting its location:

- KCSWDM 4.2.1.1. requires 3' minimum horizontal clearance and 6" vertical clearance outside of the pipe from all other utilities.
- KCSWDM Table 4.1 requires easements depending on the depth and size of pipe.

In addition to the code criteria, adequate utility spacing and depth should be planned so that maintenance activities for any of the utilities installed in this corridor are maintainable and replaceable without affecting the adjacent utilities. In addition, utilities should be planned to accommodate preliminary locations of boring and receiving pits that will be required to install the force main under I-90.

V. CONCLUSION AND RECOMMENDATIONS

The MDP calculations for the pump station and force main system are in excess of the code requirements. The concept of the pump station was to provide a substitute for detention and not to replace the existing conveyance system that serves a separate purpose.

We recommend designing the system to meet drainage code requirements. It is our opinion that this approach meets all of the goals of the MDP. The following is a summary of our recommendations on how to accomplish this:

- Remove TDA 2, the Rowley Center, from the tributary area of the pump station and force main.
- Utilize a methodology of pump station and force main sizing that is consistent with Level 2 Flow Control as required by code instead of the sizing criteria noted in the MDP.
- Utilize existing conveyance system tributary to Tibbetts Creek for base flows and for flows in excess of those required for Level 2 Flow Control.
- Eliminate conservative assumptions such as 100% impervious surface and utilize realistic values. Utilize more realistic, but still conservative ratio for pervious coverage.
- Select a force main size that results in approximately 12 feet per second at the design flow rate.
- Design and install the force main in NW Poplar Way per Section IV so that new utilities associated with the Mull Farm Apartment Project are planned to accommodate the force main and to avoid future trenching work in NW Poplar Way.

This analysis is based on the MDP TDAs minus TDA 2, but excludes any non-Project properties that may wish to contribute to the design and construction of this system. With the update of the detention requirements for areas within the Tributary 170 basin, it appears there are no feasible non-project properties east of 17th Avenue NW. Rowley Properties has been in contact with non-project properties west of Tibbetts Creek in close proximity to Hyla Crossing that may be potential contributors to the system that are subject to Level 2 flow control. Should Rowley Properties choose to partner with one of these parties, then additional TDAs will be added to the calculations to account for the additional tributary area.

Pre-Wetland condition modification

	8 FPS			12 FPS			20 FPS		
	Pipe I.D. (IN)	Pressure at Pump Station* (PSI)	Friction Head Loss (FT)	Pipe I.D. (IN)	Pressure at Pump Station* (PSI)	Friction Head Loss (FT)	Pipe I.D. (IN)	Pressure at Pump Station* (PSI)	Friction Head Loss (FT)
Match 1/2 2yr - 50yr Durations (Pre-Wetland) 14.1 CFS	18	17.0	34.1	**15**	**41.3**	**90.2**	12	130.8	296.6
Match 1/2 2yr - 50yr Durations (Pre-Forested) 21.7 CFS	23	15.6	31.1	19	40.2	87.8	15	135.0	306.3
100yr SBUH - 100yr KCRTS Predev 52.7 CFS	35	10.7	19.7	29	25.4	53.5	22	105.2	237.7

* Assuming the elevation of the lake surface is at EL 35' and pump is at EL 30' (buried 20' underground in vault).